

GENERAL LIBRARY
D 1919
CHEMICAL LIBRARY

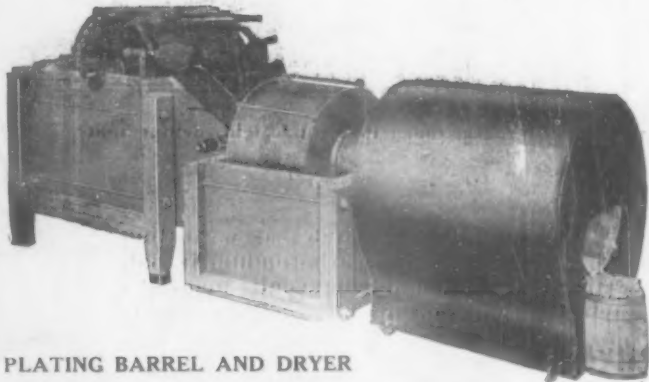
THE METAL INDUSTRY

WITH WHICH ARE INCORPORATED
THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER:
ELECTRO-PLATERS REVIEW

Entered as second class matter February 10, 1903, at the post-office at New York under the Act of 1879.

A MONTHLY JOURNAL RELATING TO THE METAL AND PLATING TRADES

REDUCE YOUR COST OF PRODUCTION



PLATING BARREL AND DRYER

—automatically plates, washes, drains and dries all small material.

Automatic Apparatus

SELF EMPTYING PLATING OR ELECTRO GALVANIZING BARREL (Patented) for automatically plating or electro galvanizing small material.

MOVING TANK (Patented) for plating or electro galvanizing material of medium size.

BAR IRON AND PIPE TANK (Patented) for automatically cleaning, rinsing, plating, electro galvanizing and rinsing bars, rods, angles, pipes and elongated material.

WIRE PLANT (Patented) for automatically cleaning, rinsing, plating, electro galvanizing and rinsing round or flat wire in continuous lengths.

PICKLING, CLEANING AND DRYING APPARATUS (Patented) for pickling brass and steel stampings.

CLEANING, RINSING AND DRYING APPARATUS (Patented) for cleaning screw machine products or small stampings.

You need no longer fear the high cost of labor, high cost of material and increased competition with the temporary falling off in demand. With U. S. ELECTRO GALVANIZING CO.'S

CLEANING and PLATING APPARATUS

You can secure increased output, better product and at a minimum of labor cost. Let us send you circulars showing how you can install this apparatus to your advantage.



CLEANING, RINSING AND DRYING APPARATUS

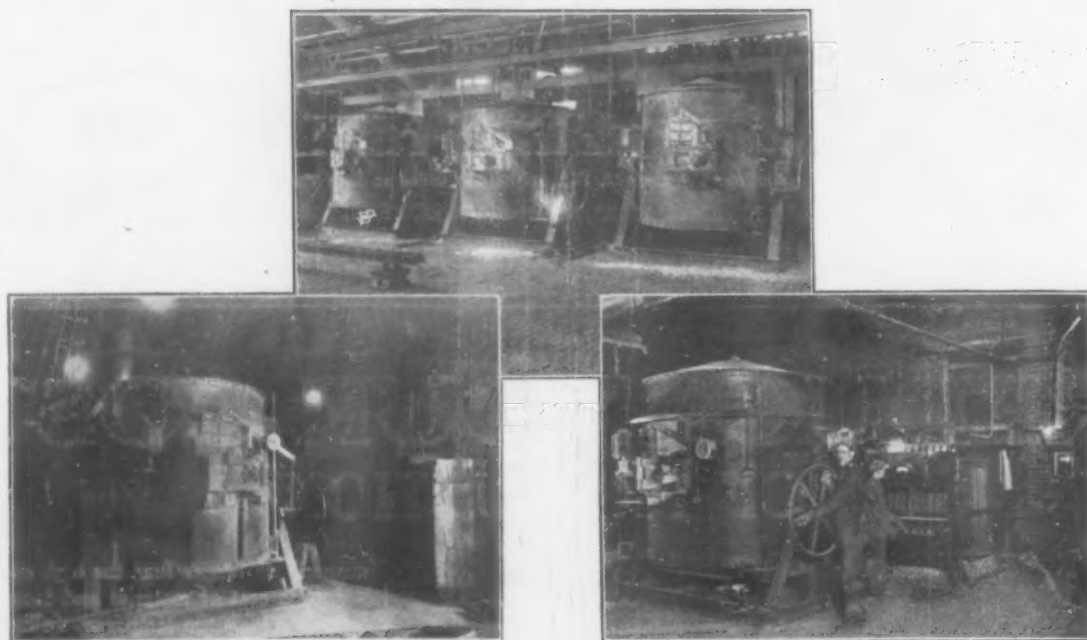
—automatically cleans, rinses and dries screw machine products, small stampings, etc.

Send for Catalogue M.

U. S. ELECTRO GALVANIZING CO. 34 STOCKTON ST.
BROOKLYN, N. Y.

BAILY ELECTRIC FURNACES

FOR MELTING BRASS



Three typical installations, each began with a single furnace, today they total eight melting units

A Simple, Rugged Furnace

The Baily Resistance Type furnace does not use electrodes as a heating medium, but produces incandescent heat by means of a carborundum trough packed with granulated carbon. Heat is radiated down evenly upon the whole hearth. The absence of complicated parts means less melting trouble and less time spent in repairs.

With Maintenance Costs Guaranteed

Our contract guarantees metal losses, current consumption, and the total cost of upkeep per ton of metal melted. This covers every item of furnace maintenance.

Establishes Better Working Conditions

When it is hard to find men physically capable and willing to handle brass melting furnaces, then it is time to let an electric furnace perform the arduous tasks mechanically. It will bring clean, wholesome conditions to replace the smoke, fumes and drudgery.

This Baily Electric Brass Furnace is described in our

BOOKLET 5-B

THE ELECTRIC FURNACE COMPANY

ALLIANCE, OHIO

THE METAL INDUSTRY

WITH WHICH ARE INCORPORATED

THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER:
ELECTRO-PLATERS REVIEW

Vol. 17

NEW YORK, OCTOBER, 1919

No. 10

Owing to the printers' strike in New York City, which delayed the issue of THE METAL INDUSTRY, we were unable to place our October number in our readers' hands until the present. The number is also short twenty-four pages of reading matter, but we shall make up this discrepancy in subsequent issues. We thank our subscribers and advertisers for their forbearance.

CONSIDERATIONS AFFECTING BRASS MELTING IN THE GRAY IRON SHOP

A PAPER PRESENTED BEFORE THE FOUNDRYMEN'S CONVENTION, AT PHILADELPHIA, SEPTEMBER 30, 1919

By R. R. CLARKE, SEATTLE, BRASS FOUNDER

Melting stands high among the particulars of brass practice. Representative experience will scarcely dissent from the opinion that inferior castings more frequently result from incorrect mixing and melting than from all other causes combined. Molders make their own scrap; furnaces can make everybody's.

All reputable brass foundries appreciate the significance of melting and equip along the lines and policies dictated by experience. The iron shop making brass occasionally is not so favorably situated. Lack of time, knowledge or inclination sponsors neglect of the importance of melting and often forces the inevitable consequence in the castings. Discussing the question from the iron viewpoint, we can scarcely realize that exhaustion of detail so absolute to exclusive brass experience. We shall, however, aim to cover the general features, hoping that those interested may be able of themselves to fill in the more important particulars.

From a melting standpoint, nonferrous is by no means ferrous; neither is an alloy of either a combination of the other, nor is any alloy of any constituency identical with any alloy of any other composition or to any one metal element entering into the composition. Every metal element has its melting peculiarities in both single and combined state and these broad facts of difference are fundamentally requisite to results. With them iron men must strive to do as brass men do, recognize and reckon with these differences.

The subject may best be discussed under its separate heads. First let us consider metal selection and mixing practice. Common practice among iron men leans toward loose brass scrap of unknown composition and indefinite antecedents. This tendency is a bad one in that all the constituents in the different nonferrous alloys are not congenial to each other when thrown together in a conglomerated mass. Thus a quantity of loose scrap containing some yellow brass, some red, some Tobin bronze, manganese bronze, some phosphor bronze and some aluminum bronze for instance—and in indiscriminate scrap it is easy to find all these

types of alloy—would make a bad metal to handle besides yielding physical properties in the casting entirely unfit for any practical purpose in general. Experienced brass men can fairly well judge brass scrap by color, fracture, etc., though the best brass foundries go farther than that through analysis in their laboratories. To the average iron foundry these advantages are denied so the better policy is to purchase and use selected scrap approximating known composition. It would perhaps be better still to purchase scrap brass ingot under analysis; this comes but slightly higher than loose scrap. In so purchasing, it is well to patronize reputable sources, since not all the firms making scrap ingot turn out a high grade product. Scrap ingot usually may be divided between that con-

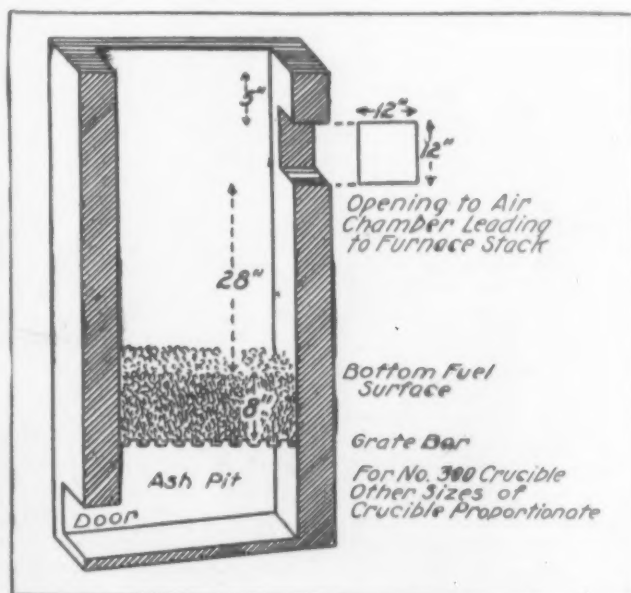


FIG. 1.—SATISFACTORY PIT FURNACE

taining zinc or that high in zinc and that including no zinc or low in zinc.

Zinc is highly determinative of certain alloy qualities. It controls color, density, toughness, malleability and cleanliness but loses out in hardness and in anti-frictional qualities. Thus we want zinc in golden color metals, in most pressure metals and in the softer, tougher metals. But we cannot have much of it in the harder metals or in the bearing metals. On tin and lead we must rely for these respective requisites.

If the iron foundries doing occasional brass work would keep two kinds of ingots on hand, the one inclusive and the other exclusive of zinc, and at the same time carry a limited stock of virgin copper, tin, lead and zinc they could approximate at reasonable cost a high grade alloy of most any desired constituency. They could do this by adding one or more new metals at the expense of others in the ingot as the case might require. Out of an ingot approximating copper 80, tin 10 and lead 10, which is an excellent bearing metal, they could by adding 90 pounds of copper and 10 pounds of zinc to 100 pounds of the ingot realize a high grade red brass applicable to the average purpose. This metal would approximate very closely the formula copper 85, tin 5, lead 5 and zinc 5, which is quite common and reputable in brass foundry work.

When loose and indiscriminate scrap must be resorted to, some effort at least should be made to pick it over and get the best for the more particular cases. The better grades of brass will usually be found in such castings as valve bodies, stems, disks, bonnets, glands, plugs or keys; and also in the better class of plumbing goods, in locomotive steam castings, and in most cases where the casting is known to have rendered some particular red brass service.

In making up alloys from new metals altogether, the order of adding the metals is important. The general and safe rule is to melt the copper to a fair liquid state, add the tin and lead and finally the zinc, stirring the bath well during the entire process of adding all metals. The zinc should be added in small rather than large pieces and thoroughly stirred into the bath. Though somewhat foreign to the subject, a passing glance at the more common metals used in brass alloys and their effects on each other might be worth while. These metals are copper, tin, lead and zinc. An idea of the function of each will appear in the following table:

		Color	Prevailing property	Oxidizing tendency	Fracture	Common Alloy	Uses
COPPER	+ tin =	pale	hardness	strong	fine	cop. 80, tin 20 cop. 83½, tin 16½	Bells
	+ lead =	grayish	plastic	strong	medium coarse	cop. 70, lead 30 cop. 50, lead 50	Bearings and steam packing
	+ zinc =	yellow	soft and tough	overcome by zinc	fine	cop. 70, zinc 30 cop. 66½, zinc 33½	Tubing, sheeting, ornamental and rolling mill work
	+ tin + lead =	pale	medium hard and strong	strong	medium fine	cop. 80, tin 10, lead 10 cop. 78, tin 7, lead 15 cop. 80, tin 8, lead 12	Bearings
	+ tin + lead + zinc =	reddish	medium hard, strong and tough	controlled by zinc	somewhat crystalline	cop. 85, tin 5, lead 5, zinc 5 cop. 86, tin 3½, lead 3½, zinc 7	Steam pressure metals
	+ tin + zinc =	reddish	hard, strong, tough	strong and proportionate to zinc	crystalline	cop. 88, tin 10, zinc 2 cop. 87, tin 8, zinc 5	Bushings, large valves, gear wheels
	+ phosphorus =	pale	hard, brittle	completely dominated by phosphorus	fine	cop. 90, phosphorus 10 cop. 85, phosphorus 15	These alloys are never used except as concentrates to facilitate introducing phosphorus into the different alloys

Contamination is a great evil in a brass alloy and of these contaminating metals none is more detrimental than iron. The eternal vigilance of the brass foundry man is required to keep iron strictly out of his alloys. From this simple fact iron foundries can learn a valuable lesson in the use for brass purposes of furnaces, ladles, gates, stirring rods, etc.

The second consideration is the melting medium. For

brass melting we have as a possibility the use of crucibles in a pit furnace with either natural or forced draft. The air and oil furnace, the gas-fired furnace, the electric furnace and in some cases the cupola, also are employed. Pit melting with proper equipment is very efficient but at the same time expensive, due to the crucible item. It takes more than a mere hole in the ground lined up with fire brick and connected with a stack to make a good pit furnace. Certain dimensions and relations must be observed as shown in Fig. 1, which is taken from a very satisfactory furnace used by the author for years. Good practice in pit melting consists in a substantial bottom bed of coke, in keeping the crucible in a centrally standing up position, in being careful to keep the coke from covering or falling into the melting or molten metal and in protecting at all times the surface of this metal from the oxidizing influence of the atmosphere and from the gases of combustion. One of the best known and efficient protectives against these is common charcoal pounded up into small pieces and placed in goodly quantity over the metal surface. Another common practice is to use pulverized glass which fuses and forms an almost seamless covering.

Pit melting expense can be greatly reduced by proper care of crucibles. In this connection the following will be found valuable:

- 1.—Crucibles should be kept in a warm, dry storage room.
- 2.—When not in use for any length of time they should be returned to this storage room.
- 3.—They should always be properly annealed before entering the furnaces.
- 4.—Proper annealing consists in a very slow raising of the temperature to at least 150 degrees Cent. The applied temperature should likewise be uniformly distributed.
- 5.—They should be given careful protection in poking the fire.
- 6.—Pigs or chunks of solid metal should never be placed in wedging form into crucibles.
- 7.—Heels of metal should not be permitted to freeze up in them.
- 8.—Tongs should be made and kept in such condition as to lift the crucible without squeezing it unduly or at any one point.
- 9.—Using the top edge of a crucible as a lever fulcrum by which to lower heavy pieces of metal or throwing

chunks of metal into crucibles carelessly is destructive practice.

10.—Direct contact of flame on a crucible not annealed or on one in process of annealing is superlatively injurious.

11.—When melting by air and oil, an end to be striven for is to avoid striking the crucible with the air and oil jet or flame. Such practice scores the crucible away.

Pit melting by gas instead of coke is quite practicable though dependent largely on facility and cost of fuel supply. Insofar as metal results are concerned there seems to be little if any difference.

Air and oil melting is the decided tendency of the day. Properly executed it is an efficient and convenient method, comparatively inexpensive. There is much about it, however, to engage judgment and common sense. Primarily essential is proper and dependable auxiliary equipment. This lies at the very foundation of successful manipulation. Good air supply is represented by ample volume but not too great pressure.

The proper flame, and consequently the correct proportions, of air to oil are best judged by color. A flame too white or clear or one tinged with green is oxidizing and decidedly detrimental. Personally, we prefer a soft flame, clear and all but smokeless yet not absolutely void of a remote yellow suggestiveness. The temptation to conserve oil is always strong, but it is well to remember that oil is cheaper than metal when the conserving desire becomes unwisely active.

SELECTION OF THE FURNACE

The different makes of air and oil furnaces are many, and for the most part reputable. In stating a preference we base our opinion entirely on the results we have obtained from the object of our partiality. Nor do we presume to intimate that, given the same careful study and attention for the same time, other makes of furnace would not have yielded results equally satisfactory. We prefer the Schwartz furnace because in our present position we inherited it, studied it and realized the very best results from it. With a Rockwell or a Monarch, for instance, we have little doubt but that we could have made a similar showing, as others have done with them. In every detail we have found the Schwartz eminently satisfactory and have melted all kinds of alloys, of scrap and different metal elements with a very low percentage of impaired metal. For a long time now we have melted exclusively in Schwartz furnaces and cannot see that any

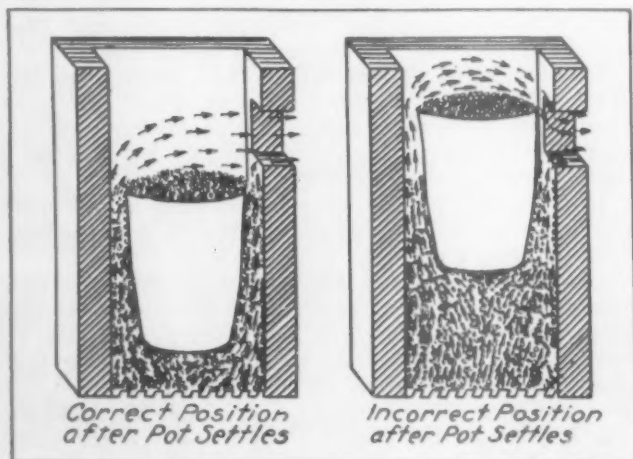


FIG. 2—POSITION OF CRUCIBLE IN PIT FURNACE

other types of furnaces or methods of melting could have given any better results. They must, however, be given careful attention in which the following points are chiefly important:

FURNACE OPERATION

1.—Keep them scrupulously clean. Slag out and clean well after every heat.

2.—See that no sutures or bare spots are allowed to exist in the lining.

3.—Do not permit undue accumulation of slag on the molten metal.

4.—Watch the flame closely, seeking to realize a good reducing flame not too violent.

5.—Use a good grade of oil.

6.—Do not allow the air to be on while the oil is off.

7.—In melting large heats change the position of the furnace frequently by rocking it.

8.—Never expose the metal to the flame a moment after the proper metal temperature has been reached. Soaking metal is one of the primary evils of melting.

9.—Melt and dispose of the metal as quickly as possible.

10.—Strive as far as practicable to keep charcoal on the metal surface, especially during the period from its first molten state up to its pouring temperature.

11.—After the metal has been reduced to a fairly liquid state, open the furnace, skim off the accumulated slag and dross, throw on a good sized shovelful of coarse charcoal, and then restart for heating up to proper temperature. Other than this no interruption should occur in the melting process.

12.—When transferring metal from the furnace to the mold, ladles should be clean, well preheated and the metal surface always should be covered with a fresh layer of pounded charcoal.

METAL TEMPERATURES AND PROTECTION

Next we strike the question of metal temperatures and metal protection, the latter including the important question of fluxes and reagents. All these can be best considered jointly. The two great evils attending brass melting are oxidation and gas absorption. The former will be best understood from the statement of the fact that practically all known metals at certain temperatures combine rapidly with oxygen, producing either an oxidized metal or a complete metal oxide. To oxidize really means "to combine with oxygen" and is in many respects synonymous with the common expression "to burn."

The difference between "oxidized metal" and metal oxide we observe as that between a metal only partially oxidized and one completely oxidized. In the one case we have as it were a "scorched" metal, in the other a metal completely burned to dross or ashes. Oxidation is a consequence chiefly of contact with the atmosphere which is a mechanical mixture of oxygen and nitrogen. Oxidation increases with temperature, with exposure and with time. To minimize oxidation in melting then means to get the metal no hotter than necessary, keep its surface well protected from the atmosphere and get it out of the furnace and poured on short order as soon as it is ready. Oxidation causes weak, drossy and spongy metal, wholly unfit for any general purpose. Many castings are lost and many others fail in service by it.

FUNCTION OF CHARCOAL

A word explaining its function is worth while. Charcoal is carbon and at its "kindling" temperature has a great affinity for oxygen. Oxides floating on the surface of the metal are combinations of oxygen and metal. The function and power of charcoal is to take up the oxygen of the oxide and leave the metal clean and clear. This it does admirably, besides forming a protective covering to exclude the atmosphere. Charcoal's greatest value is in the burning which represents the chemical reaction or oxidizing process. Obviously then the top of the metal in the ladle should be well covered during pouring, with charcoal in burning state. Once burned to ashes its func-

tion practically ceases. Our charcoal bill is always high, but our castings are for most part sound.

Active fluxes are sometimes referred to as reagents and deoxidizers. Always they are highly oxygenating substances. Most common among them are zinc, phosphorus, silicon, magnesium and manganese. But three of these will require comment here, they being the most widely used and covering general requirements. If we melt pure copper and pour it into molds, chances greatly favor its rising and flowing back through the pouring gate, resulting in a porous and oxidized condition in the casting. If to this pure copper we add 3 per cent of zinc, or $\frac{1}{2}$ of 1 per cent of phosphorus, or a small amount of silicon, the evils will at once be corrected. In the copper tin-lead alloys, zinc or phosphorus only are used, silicon being accorded no standing. Zinc is seldom used for deoxidizing purposes exclusively while phosphorus usually is. The reason is that in a great many alloys zinc is used for the quality it supplies and because its presence obviates the need of any further reagent. With phosphorus this is not the case. It is used purely as a deoxidizer in those alloys from which zinc and its qualities are barred. Zinc quality is wanted in pressure-resisting metals, so it forms an equal part with tin and lead in the 85 copper alloy. It is not wanted in a bearing metal, so the 80-10-10 copper, tin, lead alloy is fixed up with from 0.5 to 1 per cent of phosphorus. The use of both zinc and phosphorus in the same alloy is considered bad practice, especially high percentages of either. Used purely as a deoxidizer from 2 to 5 per cent of zinc and from 0.25 to 1 per cent of phosphorus will suffice for the average purpose.

ZINC AND PHOSPHORUS BURN OUT

With high temperatures and repeated remelting, both zinc and phosphorus burn out of the alloy. In melting all scrap it is therefore good practice to add small quantities, from 1 to 2 per cent of zinc and 0.1 to 0.25 per cent phosphorus, to reciprocate that lost and control the oxides. In the case of zinc this is invariably our practice. Phosphorus is added to the alloy in the form of a concentrate which itself is an alloy of either phosphorus and copper or phosphorus and tin and known respectively as phosphor-copper and phosphor-tin. The use of either presupposes wide-awake figuring. Phosphor-copper is usually copper 85 per cent and phosphorus 15 per cent. To get 1 per cent of phosphorus consequently means the use of $6\frac{2}{3}$ pounds of phosphor-copper; and to make a 100-pound mix reading copper 79, tin 10, lead 10, phosphorus 1 requires copper $73\frac{1}{3}$, tin 10, lead 10, phosphor-copper $6\frac{2}{3}$ pounds.

Relying on phosphorus as a cure-all for loose melting practice is bad policy and it should be resorted to at times and in quantity only as unavoidable conditions require. Silicon is used almost exclusively with pure copper to reduce its gases and oxides. In practice we have never reduced its quantity to a percentage basis relying instead on judgment as influenced by varying conditions of melting and prompted by the appearance of the molten copper mass. The use of manganese and magnesium is not widespread. Charcoal is not a logical flux for aluminum which does better under chloride of zinc.

THE QUESTION OF POURING TEMPERATURE

On the pouring temperature depends largely the cleanliness and solidity of brass castings. No wide margin lies between a proper temperature and one too low or too high. Generally it is better to pour hot than cold, though the consequences of either extreme are equally distressing. From cold metal come bad shrinking, drawing, drossy and spongy metal and improper metal unions

between different casting sections. From metal too hot arises the porous and honeycombed effect caused by the dreaded gases.

To discuss pouring temperature at length is not within the province of this paper. In passing we pause to point out an important particular, namely that there is a heavy loss of temperature between the furnace and the mold with the mold the determinate point and that the more this loss can be reduced by well preheated and clean ladles, by rapid disposition of metal, etc., the better the results will be. It is a fundamental principle of good brass melting practice to get the metal no hotter than necessary and hold it no longer than absolutely required.

Summing up this paper we note the following:

- 1.—Good metal is essential to good castings.
- 2.—Unknown scrap indiscriminately used can never be trusted to produce a clean, solid casting.
- 3.—Percentages of new metal along with scrap greatly improve quality.
- 4.—Whatever the melting method, dependable equipment and right ways of doing things are indispensable requisites.
- 5.—Iron must be kept strictly out of brass.
- 6.—Brass can be melted by pit-crucible furnace, air and oil furnace, electric furnace and by cupola. Present day practice is largely air and oil.
- 7.—Cleanliness of furnaces, ladles, etc., makes for metal quality.
- 8.—Slag is distinctly detrimental.
- 9.—Rapid melting and quick disposition of metal favors results.
- 10.—A reducing flame is a melting flame with a minimum of oxidation and represents correct proportions of air and oil at proper pressure. Its color is white, remotely yellow.
- 11.—An oxidizing flame melts and oxidizes seriously. Its color is extremely pale intermingled with green and the flame is very thin.
- 12.—Good fuel is a melting asset.
- 13.—Holding (soaking) metal in the furnace following its readiness is among the worst of evils.
- 14.—Absorption of gases originates chiefly in high metal temperatures in the furnace and at pouring. Pouring temperature is therefore an important item.
- 15.—Oxidation derives mainly from atmospheric contact and increases with time, temperature and surface exposed. Its prevention lies in the protection given the metal surface and in the neutral fluxes. Its cure lies in the active fluxes or deoxidizers.
- 16.—Charcoal has an indispensable value in preventing and reducing surface oxides. It should be generously resorted to as a covering.
- 17.—Phosphorus, zinc and silicon are the more common deoxidizers. With pure copper any one can be used when not otherwise barred. Phosphorus and zinc are used chiefly for the alloys, the former occurring principally in those to which the later is not included. In most any alloy not too high in zinc, copper 88, tin 10 and zinc 2, for instance, a mere trace of phosphorus makes for cleanliness and solidity of the casting.
- 18.—Lead and copper mix very imperfectly. Alloys containing more than 10 per cent lead should therefore be stirred vigorously in pouring to insure a uniform mixture.
- 19.—To slag out furnaces use lime, fluorspar, soft coal, oyster shells or common charcoal.
- 20.—Alloys containing phosphorus sand-burn the casting severely if poured too hot.
- 21.—Furnaces slag out well with lime, fluorspar, soft coal, charcoal or oyster shells.
- 22.—Prevention in melting is better than cure.

FIVE FOUNDRY TESTS OF ZINC BRONZES

A PAPER PRESENTED BEFORE THE METALS DIVISION OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS AT PHILADELPHIA, OCT. 1, 1919, BY C. P. KARR, PH.D., ASSOCIATE PHYSICIST, U. S. BUREAU OF STANDARDS, WASHINGTON, D. C.

For several years, the Bureau of Standards has been working in co-operation with an Advisory Committee on non-ferrous metals on various phases of the production and testing of zinc bronzes. The work has dealt especially with the type of metal known as "Admiralty bronze" in England and as "Government bronze" in this country and consisting of 88 copper, 10 tin, and 2 zinc. Several reports have been made on this subject, and these should be considered in connection with this paper.¹

FIRST SERIES OF FIVE FOUNDRY TESTS.

A very brief summary of the first series of five foundry tests have been made,² but for the sake of clearness the results are given here in different form. The five foundries co-operating in this investigation were: Ohio Brass Company, Mansfield, Ohio; Titanium Alloy Mfg. Company, Niagara Falls, N. Y.; Packard Motor Car Company, Syracuse, N. Y.; National Cash Register Company, Dayton, Ohio; Bureau of Standards, Washington, D. C. The object of the work was to determine whether uniform results could be obtained with this alloy in different foundries working under definite instructions.

One of the participating foundries prepared, from virgin metal, a stock of ingots of the composition 88 copper, 10 tin, 2 zinc, and at the same time poured nine test bars from this melt of virgin metal. The results of the physical tests of these bars are shown in Table 1. Examination of this table shows that the highest and most nearly uniform results were obtained when the virgin metal was cast flat in chill molds and the lowest and most variable results were encountered when it was cast vertical in green-sand molds. In this, as in all other tables, the mean deviation was obtained by the usual method of taking the average of the differences of the individual values from the average values.

A part of the ingots were sent to each of the five foundries with instructions that test bars be made in various stated ways, using not over 25 per cent. of gates and runners as scrap and maintaining pouring temperatures between 1100 deg. and 1200 deg. C. The instructions specified also that Albany No. 2 sand should be used for molds; but for skin-dried molds, allowed the use of any facing sand or binder commonly used in good foundry practice.

The instructions as to pouring temperatures were not adhered to strictly by some of the foundries, for the pouring temperatures varied from 1050° to 1350° C. Although not specified in the instructions, all sand-cast specimens were supposed to be 4½ in. (11 cm.) long and ⅝ in. (1.5 cm.) diameter in the center sections and all chill specimens were supposed to be 14½ by 2 by 1¼ in. (37 by 5 by 3 cm.). The test bars made, actually varied in length from 4½ in. to 14 in. in length and from ⅝ in. to ¾ in. in diameter, center section. In addition to these variations in pouring temperatures and size of test bars, a large number of the test bars showed flaws and many others broke outside of the gage limits when being tested. For these reasons, the results of the tests have less significance than was expected. They are valuable mainly as an example of the extreme care that must be taken to keep conditions uniform in conducting comparative

tests on metal so sensitive to slight variations in method of working as Government bronze is known to be. The results are shown in Table 2, in which the superiority of the chill casting stands out.

TABLE 1.—Five Foundry Tests, Series 1, Virgin Metal.
Composition of Charge: 88 Copper, 10 Tin, 2 Zinc.
Averaged Results of Physical Tests with Mean Deviations.

Method of Casting.	Number of Specimens.	Tensile Strength, Lb. Per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.	Number of Specimens Containing Flaws.	Number of Specimens Breaking Outside Gage.
Flat, skin dried sand	3	40,400 ±1,600	16.0 12.0	14.8 ±1.5		1
Vertical, green sand	3	38,000 ±3,300	9.7 ±3.8	6.3 ±3.2		1
Vertical, skin dried sand	3	38,000 ±3,300	12.3 ±2.9	9.7 ±3.1		1
In chill	3	44,100 ±2,900	27.3 ±2.4	23.7 ±2.3	1	

TABLE 2.—Five Foundry Tests, Series 1, First Remelt.
Composition of Charge: 88 Copper, 10 Tin, 2 Zinc.
Averaged Results of Physical Tests with Mean Deviations.

Method of Casting.	Number of Specimens.	Tensile Strength, Lb. per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.	Number of Specimens Containing Flaws.	Number of Specimens Breaking Outside Gage Limits.
Flat, green sand.15	15	36,590 ±3,190	12.0 ±4.2	10.1 ±3.6	2	9
Flat, dry sand...15	15	37,000 ±2,800	11.0 ±2.6	8.9 ±2.1	3	7
Vertical, green sand	15	33,830 ±4,700	9.9 ±4.0	9.2 ±3.7	4	5
Vertical, dry sand.....15	15	32,130 ±5,570	9.7 ±4.6	9.1 ±3.3	10	5
In chill	21	42,100 ±4,800	25.0 ±8.8	19.7 ±5.8	2	6

EFFECT OF HEAT TREATMENT.

In order to determine the effect of heat treatment on the properties of this alloy, a second remelt was made in the foundry of the Bureau of Standards. The results are shown in Table 3. Examination of this table shows that the physical properties of the specimens cast in sand were improved somewhat by heat treatment, annealing being more effective than quenching. In the specimens cast in chills, the ductility of the metal was increased markedly by heat treatment, but the tensile strength was not altered materially. The sand-cast specimens of the second remelt are better than the chill castings of the first or second remelts. These results are in general accord with those of other investigators.³

EFFECT OF CONTINUED REMELTING.

To determine the effect of continued remelting on the alloy, three remelts of the same metal were made at the

¹ Report of Work Done at the Bureau of Standards on Non-ferrous Metals During 1913. Trans. Am. Inst. Met. (1913) 7, 252-287. Standard Test Specimens of Zinc Bronze. U. S. Bureau of Standards, Tech. Paper 59 (1916). Report on a Series of Comparative Tests of Zinc-bronze Standard Test Bars. Trans. Am. Inst. Met. (1916) 10, 77.

² Last reference above.

TABLE 3.—Five Foundry Tests, Series I, Second Remelt.
Composition of charge: 88 copper, 10 tin, 2 zinc.
All specimens were cast approximately to size.
Average results of physical tests.

How Cast.	Heat Treatment.	Tensile Strength, Lb. Per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.
Flat, green sand.	Quenched at 700° C.	41,550	29	12
	Annealed at 700° C.	44,000	39	25
	None	41,230	17	13
Flat, skin dried sand ..	Quenched at 600° C.	45,300	37	22
	Annealed at 600° C.	46,610	39	27
	None	41,790	27	19.6
Vertical, green sand	Quenched at 700° C.	43,780	39	22.7
	Annealed at 700° C.	44,550	46	29.5
	None	42,000	27	10.6
Vertical, skin dried sand ...	Quenched at 600° C.	47,940	38	13
	Annealed at 600° C.	49,380	35	17
	None	39,850	25	17.5
In chill	Quenched at 600° C.	29,640	17	11
	Quenched at 700° C.	32,890	25	16
	Quenched at 700° C.	29,000	22	3
	Annealed at 600° C.	29,800	19	13
	Annealed at 700° C.	27,900	19	10
	None	31,875	5	3.5
	None	25,300	5	2.0
	None	26,000	5	2.5

Bureau of Standards. The pouring temperatures being kept at about 1100° C. The results are shown in Table 4. In the case of specimens cast in chills, the virgin metal gave the highest values, and there was a marked falling off in strength with continued remelting. No marked effect due to remelting is noticeable in the specimens cast in sand. This may be due to the maintenance of a low pouring temperature, for it is well known in foundry practice that Government bronze tends to deteriorate after two or three meltings.⁴

SECOND SERIES OF FIVE FOUNDRY TESTS.

After discussion in committee, it was decided to repeat the first remelt series of tests conducted by the five co-operating foundries but to use longer test bars cast in molds made from core sand and linseed oil and baked in a core oven. These molds were all made for pouring flat and were all provided with reservoir gates, the gates being made in green sand. The shape and dimensions of the mold and gate are the design of Mr. McKinney, of the Naval Gun Factory, and are shown in Fig. 1. It was decided further to conduct a similar series of tests on ingots of the composition 88 copper, 8 tin, 4 zinc. The pouring temperatures varied somewhat, from 1100° to 1300° C., due to established practice in the various foundries, but otherwise conditions were kept as uniform as possible. The care taken in making this series of tests was justified by the facts that none of the specimens broke outside of the gage limits while being tested and none showed flaws. The results of the physical tests are shown in Tables 5 and 6.

Examination of these tables shows that even with rather carefully standardized methods of making test bars of this type of alloy, there may be considerable variation in

the physical properties of bars produced in the same foundry and greater variation in those from different

TABLE 4.—Five Foundry Tests. Composition of charge: 88 copper, 10 tin, 2 zinc. Showing effect of continued remelting. All melts except that of virgin metal were made at the Bureau of Standards. Average results of physical tests with mean deviations.

Method of Casting.	Number of Melt.	Number of Specimens.	Tensile Strength, Lb. Per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.
Flat, green sand..	1				
	2	3	38,200	10.0	8.5
			±800	±0.6	±1.1
	3	3	42,600	7.3	11.5
			±1,000	±0.6	±1.0
	4	3	40,100	9.0	10.5
			±3,800	±2.0	±3.3
	Flat, skin dried sand 1	3	40,400	16.0	14.8
			±1,600	±2.0	±1.5
	2	3	40,400	11.0	8.1
			±600	±1.3	±1.2
	3	3	42,800	14.0	20.0
			±1,300	±0.3	±5.0
	4	3	43,100	15.0	18.0
			±2,400	±3.0	±4.0
Vertical, green sand 1		3	38,000	9.7	6.3
			±3,300	±3.8	±3.2
	2	3	38,200	15.0	13.5
			±2,300	±0.6	±3.9
		3	36,500	4.7	10.0
			±2,000	±0.2	±0.3
	4	3	35,500	9.0	8.0
			±1,300	±1.6	±2.0
Vertical, skin dried sand	1	3	38,000	12.3	9.7
			±3,000	±2.9	±3.1
	2	3	35,700	12.3	10.3
			±2,600	±3.5	±3.8
		3	37,500	8.5	13.0
			±1,950	±2.0	±2.3
	4		35,400	9.0	9.5
			1,000	±2.0	±1.3
In chill	1	3	44,100	27.3	23.7
			±2,900	±2.4	±2.3
	2	3	43,800	20.0	16.2
			±3,500	±6.0	±5.8
		3	31,600	4.0	6.0
			±3,700	±0.8	±3.1
	4	6	25,600	1.8	2.6
			±3,200	±0.3	±1.1

TABLE 5.—Five Foundry Tests, Series II. Composition of charge: 88 copper, 10 tin, 2 zinc. All specimens were cast approximately to size, horizontal, in baked core-sand molds with reservoir gates.

Averaged results of physical tests with mean deviations					
Foundry.	Number of Specimens.	Proportional Limit.	Tensile Strength, Lb. Per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.
A	6	11,250	33,600	22.3	18.0
		±1,300	±1,400	±1.1	±2.0
B	6	13,100	43,100	39.7	24.3
		±1,050	±3,350	±4.5	±2.2
C	6	13,750	42,600	31.3	24.6
		±600	±2,200	±5.0	±3.4
D	6	10,000	31,100	17.8	15.8
		±1,500	±2,500	±4.4	±4.3
E	6	13,100	43,800	25.1	22.5
		±900	±1,950	±4.5	±4.5
Total	30	12,200	38,900	25.3	21.0
		±1,600	±5,250	±5.9	±4.7

¹ E. S. Shepherd and G. B. Upton: Jnl. Phys. Chem. (1905) 9, 441-476.
St. Etienne: Soc. de L'Ind., Stoye Memorial (Mch., 1911) 138.
H. S. and J. S. G. Primrose: Jnl. Inst. Met. (1913) 9, 161.
M. S. Guillet: Rev. de Met. (1905) 2, 118.
John Dewrance: Jnl. Inst. Met. (1914) 11, 216.
C. P. Karr and H. S. Rawdon: Tech. Paper, U. S. Bureau of Standards.
H. C. H. Carpenter and C. F. Elam: Jnl. Inst. Met. (1918) 19, 155.
⁴ Decourcy Brown: Trans. Am. Inst. Met. (1914) 8, 63. Brass World (1913) 9, 176.

TABLE 6.—Five Foundry Tests, Series II. Composition of Charge: 88 copper, 8 tin, 4 zinc. All specimens were cast approximately to size, horizontal, in baked core-sand molds with reservoir gates. Average results of physical tests and mean deviations.

Foundry.	Number of Specimens.	Proportional Limit.	Tensile Strength, Lb. Per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.
A	5	12,400	46,000	40.0	30.0
		$\pm 1,700$	$\pm 1,000$	± 3.0	± 1.7
B	6	11,900	43,300	36.0	28.0
		± 900	$\pm 1,850$	± 4.5	± 4.5
C	6	10,200	34,600	29.5	24.4
		$\pm 1,000$	$\pm 2,400$	± 5.2	± 3.0
D	6	9,600	36,400	31.5	23.6
		$\pm 1,400$	$\pm 2,400$	± 5.7	± 3.4
E	3	11,300	35,900	15.3	14.6
		$\pm 2,900$	$\pm 3,750$	± 7.1	± 5.6
Total	26	11,000	39,400	32.0	25.0
		$\pm 1,650$	$\pm 4,200$	± 7.0	± 4.6

foundries. The results for the alloy 88 copper, 8 tin, 4 zinc compared with those for 88 copper, 10 tin, 2 zinc indicate that it is a somewhat more ductile metal than the 88-10-2 mixture, has about the same tensile strength, but a lower proportional limit. It is interesting to note that some of the foundries that produced specimens with highest values with the 88-10-2 alloy made bars with the 88-8-4 alloy that gave some of the lowest values, and vice versa. This is probably due, largely, to the pouring temperatures used in the foundries in question being more suitable for one alloy than for the other.

SUMMARY.

In conducting comparative tests of alloys of the Government bronze types, great care must be taken to keep uniform all conditions affecting the quality of the finished castings, such as composition of charge, pouring temperature, shape and size of test bars, kind of mold used, method of pouring and gating, etc.

With rather carefully standardized methods of making test bars of this type of alloy, considerable variation in

Two alloys studied gave the following average values for test bars cast approximately to size horizontal in baked core-sand molds with reservoir gates.

Composition.	Number of Specimens.	Proportional Limit.	Tensile Strength, Lb. Per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.
88 Cu, 10 Sn, 2 Zn	30	12,200	38,900	25.3	21.0
		$\pm 1,600$	$\pm 5,250$	± 5.9	± 4.7
88 Cu, 8 Sn, 4 Zn	26	11,000	39,400	32.0	25.0
		$\pm 1,650$	$\pm 4,200$	± 7.0	± 4.6

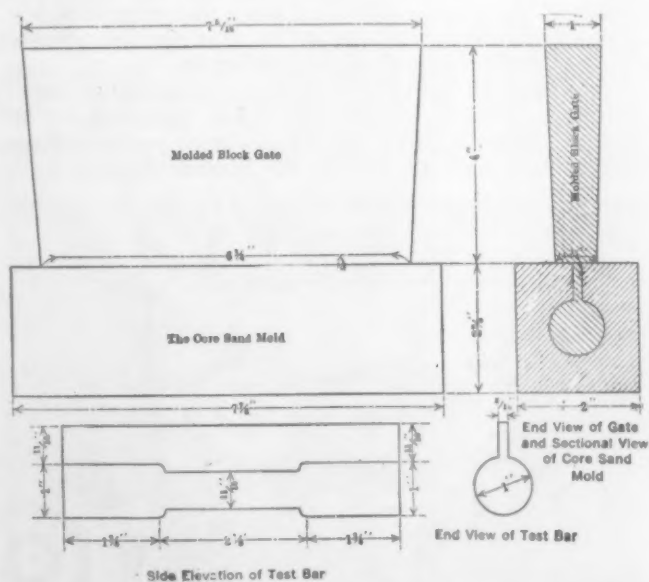
SECONDARY METALS RECOVERED IN THE U. S. IN 1918

By J. P. DUNLOP, U. S. GEOGRAPHICAL SURVEY

COPPER		Short tons.
Copper from scrap, drosses, ashes.....		88,130
Copper in alloys other than brass		34,380
		122,510
From new scrap		36,000
From old scrap		86,510
		122,510
Brass scrap melted:		
New clean scrap		200,000
Old scrap		128,800
		328,800
Copper content of brass scrap (averaging about 70 per cent copper):		
New scrap		140,000
Old scrap		90,160
		230,160
Total copper produced from secondary sources:		
From new scrap		176,000
From old scrap		176,670
		352,670
Exports of scrap brass in 1918.....		2,455
Exports of scrap copper in 1918.....		129
Imports of scrap brass in 1918		6,114
Imports of scrap copper in 1918		959

LEAD

Secondary lead recovered by smelters that treat mainly ores	7,276
Secondary lead from plants treating only scrap and drosses	33,870
	41,146
Secondary lead contained in remelted alloys:	
Lead content of antimonial lead scrap treated at regular lead smelters.....	2,328
Lead in drosses and scrap alloys recovered at secondary smelters	53,626
Total in alloys	55,954
Total recovery of secondary lead.....	97,100



TYPE OF TEST BAR USED IN SECOND SERIES

physical properties of test specimens from the same foundry are to be expected and greater variation in those from different foundries.

GAUGES AND STANDARDS FOR MANUFACTURING BRASS GOODS.

THE UNIFICATION AND SIMPLIFICATION OF ENGINEERING STANDARDS

WRITTEN FOR THE METAL INDUSTRY BY P. W. BLAIR.

In many lines of engineering much excellent standardization work had been done before the war. The war emphasized its importance and showed most clearly the need of co-operation to prevent the confusion caused by the promulgation of overlapping standards by independent bodies.

The National Brass Manufacturers Association at their summer meeting held in Cleveland appointed a committee for the standardization of types in brass fixtures and it is predicted that in the near future a committee will be appointed on standardization of screw threads in the manufacture of plumbing and steam brass goods.

At the present time some of the brass manufacturers have adopted standards of their own in tapers and diameter of threads on certain lines of brass goods and others have adopted a straight thread on all female iron pipe connections in place of a standard taper $\frac{3}{4}$ " to the foot. The argument has been put forward that by employing a straight parallel thread on a female connection and taper thread on the male connection a more perfect joint can be formed. This theory has been proved erroneous through severe high pressure tests that have been made on connections.

The American Engineering Standards Committee has just completed and adopted a revision of its constitution which has been sent to the governing boards of all the departments and societies represented on the committee with a request for its ratification.

They have also changed their name to the American Engineering Standards Association, the change from committee to association more fittingly indicating the wide scope of the interests involved.

The main objects of this association are to unify and simplify the methods of arriving at engineering standards, to secure co-operation between various organizations and to prevent duplication of standardization work.

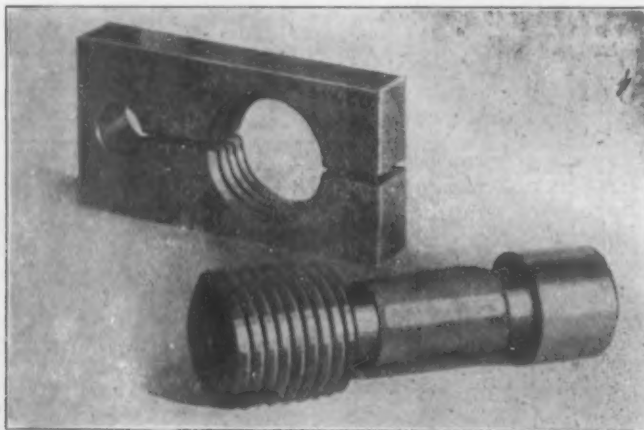


FIG. 1—U. S. STANDARD INTERNAL AND EXTERNAL GAUGES

The exceptional merit of the United States Standard Thread System has long been acknowledged and the importance of its general adoption has been persistently urged by the engineering profession.

Its universal adoption as the standard for all Government work in the United States is largely due to the fact that it is the only form of thread by which interchangeability in manufacturing is possible.

The United States Standard form of thread has 60 degree included angle and is fat at the top and bottom of the thread, an amount equal to $\frac{1}{8}$ of the pitch.

These gauges are made with a flat top and sharp bottom the measuring contact with the gauge being

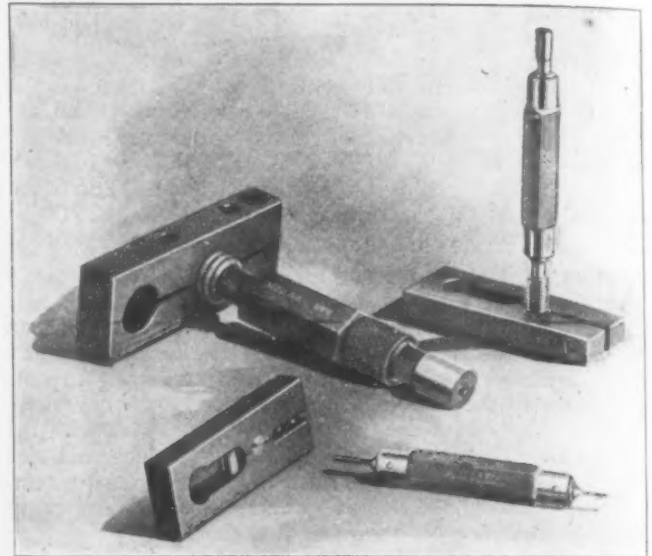


FIG. 2—GAUGES FOR MACHINE SCREENS

on the angle only. These gauges are intended as working standards, the internal gauge or plug being the standard to which the external templet is adjusted, means for which are fully provided. The end opposite the thread furnishes the exact diameter at the root of the United States standard thread.

The A. S. M. E. standard, (so called to distinguish it from the United States Standard thread) is the outcome of the efforts of the American Society of Mechanical Engineers to place the manufacture of machine screws upon a more practical basis.

The form of thread is the same as the United States standard. There has been another standard set of gauges adopted with the past few years. These gauges have been adopted by the Society of Automobile

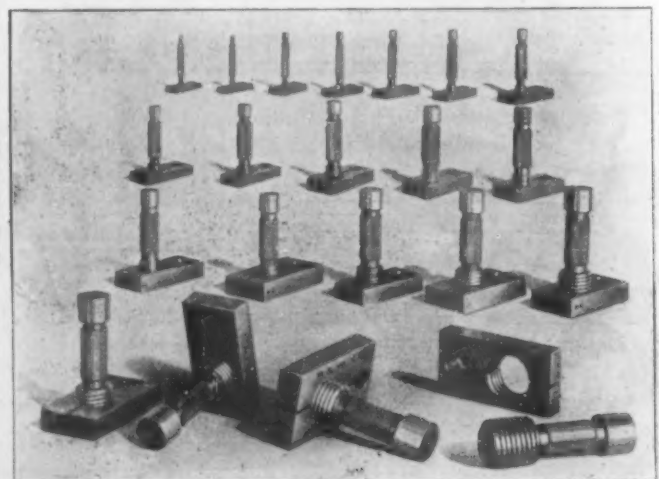


FIG. 3—SOCIETY OF AUTOMOBILE ENGINEERS' STANDARD GAUGES

Engineers. The form of thread is the same as the United States standard but the pitches for the different diameters are finer. There are a large number of brass manufacturers using these sizes in the manufacture of their goods, as, owing to the finer pitch of threads they become applicable, and it is the means of enabling them to use the standard taps which can be purchased from the tap manufacturers in place of having to manufacture special taps in their own plant at a heavy cost.

As the Acme standard thread has superseded the

with the master gauges and any wear or damage corrected.

Snap or caliper gauges occupy a very prominent place in works of manufacturers who are desirous of

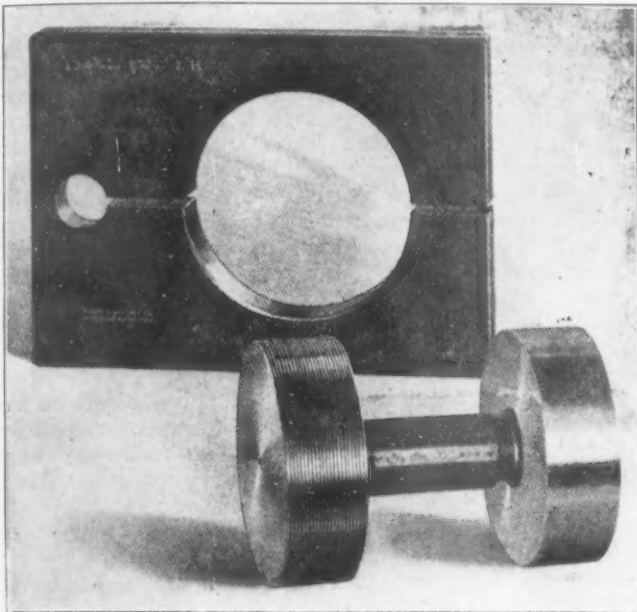


FIG. 4—SPECIAL SIZE GAUGES

place of the square thread in manufacturing, more especially in the manufacture of brass goods where it is now universally employed.

The Briggs standard pipe thread gauges are universally used by makers of steam water and gas brass goods. A set consists of a plug and a ring on the plug. A surface is ground which indicates the depth to which the plug should freely enter the fitting, the ground portion being the correct forcing distance in order to make a tight joint.

The majority of brass manufacturers have complete sets of master gauges and do not use them directly on the work.

They are for testing and adjusting ordinary working gauges which if uniformity is to be maintained must be corrected from time to time by checking up

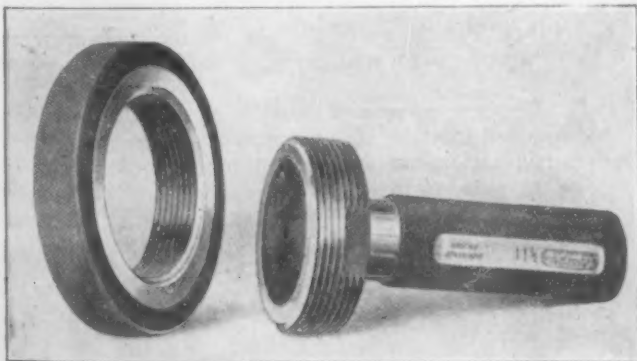


FIG. 5—BRIGGS STANDARD PLUG AND RING I. P. GAUGES

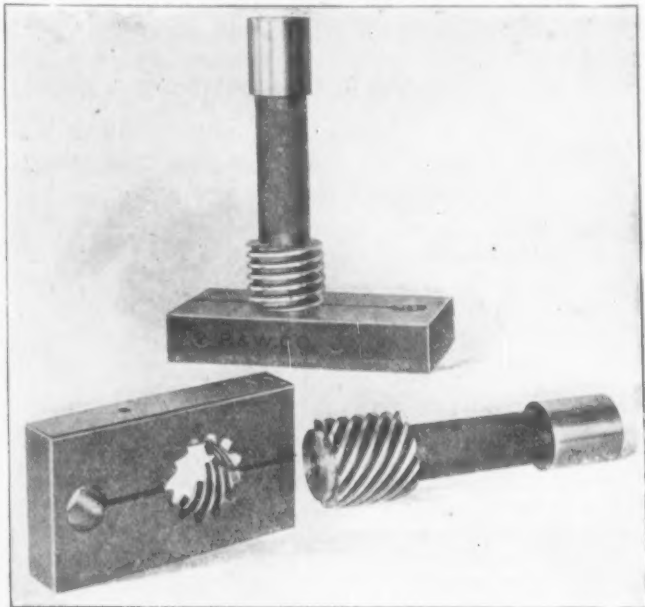


FIG. 6—STANDARD THREAD GAUGES

maintaining a standard of interchangeability in their product and should be part of the equipment of every brass manufacturing plant.

They are conveniently light and rigid and their expense of manufacture is very low. An ordinary operator can detect a very minute difference between two pieces of apparently the same diameter.

These gauges are made from drop forged tool steel and are hardened and ground to exact standard limits marked "go" and "not go."

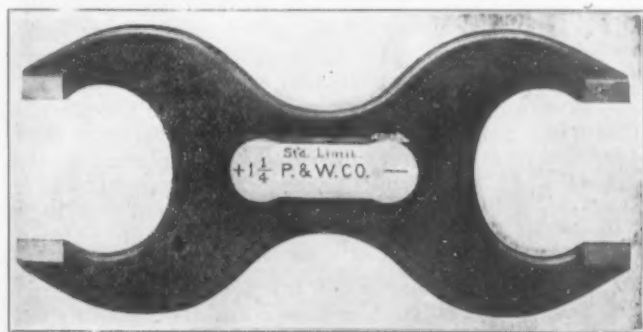


FIG. 7—SNAP LIMIT GAUGE

I believe the American Engineering Standard Committee will act as a bureau of information regarding standardization and bring those interested in a common object, and when they have completed their work will at their request certify that it has been done in such a manner to justify its adoption. Nothing revolutionary is proposed; it is merely an extension of present practice. The executive committee of the American Society for Testing Materials now passes on the composition of committees, ascertains that their conclusions are unanimous and if so reports them to the society for acceptance or rejection.

The American Engineering Standards Committee will act along the same lines. It will neither select

sponsors nor sectional committees. It will not consider the subject matter of a standard nor the procedure under which it is arrived at, except that it requires sufficient information from the sponsor to show that the conclusions are substantially unanimous and that the sectional committee is balanced and repre-

sentative. It also requires that in all publications the sponsor shall be given full credit.

Several organizations have already presented requests for the approval of existing standards and many others are now working along the same line.

THE PRIME FACTORS OF FOUNDRY EFFICIENCY

SCHEDULING OF WORK AND SHOP DETAILS.

WRITTEN FOR THE METAL INDUSTRY BY M. H. POTTER.

Efficiency as regards the despatching and handling of foundry details, the elimination of too much system, but the consolidation of necessary details, is much to be desired even in the smaller foundries. Especially in the foundry these two factors determine greatly the cost of production and the assurance of prompt shipments.

SCHEDULING.

Much of the waste time caused by delays in the foundry may be traced to faulty conditions. No doubt the management is doing the best it can to run the business in an economical manner, according to the best accepted ideas of what constitutes the best one can do. No doubt the establishment is holding its own with other foundries in turning out castings of good quality in point of material and workmanship; it is no doubt ambitious to get castings made as soon as possible. No doubt their understanding of the practical and technical end of the business is all that could be desired. Yet, with all these points in their favor, it is very evident that something is radically at fault.

Efficient procedure is the premier consideration and should be definitely planned, in order that a well formulated plan may be followed. This does not mean that the work in hand should be handled to conform to the rules of procedure, but rather that the procedure shall conform to the work. If the work has been made to submit to a definite plan of procedure, as here specified the start will receive its share of attention—as much attention as the work itself. The general neglect of the start is largely to blame for an inefficiency. Many foundry executives have failed to learn the value of a good start as applied to this particular business—in this business, probably more than in many others, as the start is of so much resultant value, for its proper adoption may be applied so extensively; this therefore important factor is worthy of study and action. The thought which should have been expanded in this direction has been concentrated on the result which is desired—the finished work.

If the situation was sized up generally as regards work under way, orders ahead, etc., and the various shop foremen were called together and the procedure for the next day talked over and each one required to outline his share of the work, much would be accomplished. This should apply not only to the foremen, but also to the men in charge of laborers and storage. The shop foreman should have a definite assignment for each man; furthermore, he should have in mind the time that the various jobs should require, which will not only enable him to know whether time is lost, but will also permit him to assign enough work to cover the man's time fully.

The core-room foreman should know what cores he is going to make for the next day's work. The pattern-storage man should know what patterns he will lay out for the work on the following day. The labor boss should know what materials he is going to bring in for the work to be made in the following day. The boss

carpenter should know what flasks he will work on to accommodate the new work coming in. The pattern-shop foreman should know what patterns to get ready for the shop. In this manner the method of procedure is definitely outlined and it is up to the general foundry superintendent or the man in charge to see that the plan of procedure is carried out. The making of a piece of work does not depend altogether upon the man actually engaged upon the work; it is also what he is given to work with and the conditions under which he works. As applied to foundry work these are extremely important, inasmuch as such work requires a good many changes in both tools and conditions. It is the duty of the shop management to see that the men are not held up because of faulty conditions.

The general conditions under which a molder works starts with foundry orders, the knowledge of and their following up, and ends with the crane facilities. The following conditions are also included:

- Storage and handling of materials and supplies.
- Selection of patterns, core boxes, flasks, etc.
- Repairing and altering of the above.
- Removal of gagers, rock, etc., from the sand.
- Tempering of molding sand and the mixing of facing sand.
- Shop carrying arrangements, rigging, etc.
- Supplying the molders with facilities, sand, nails, gagers, chaplets, blacking or wash, clamps, wedges, etc.
- Furnishing the molder with proper tools.
- Arrangements effecting the general shop labor.

Foundry dispatching depends, of course, upon the parties concerned, the planning and the execution according to the plans. Faulty conditions fail to exist when proper attention is given to them. The persons concerned are those in charge of the various departments, including the most unimportant executive.

ARRANGING THE WORK.

Planning consists of:

- Selection, who the work is to be performed by.
- Location, where it is to be made.
- Time, when it is to be made.

Procedure, how it is to be made and with what it is to be made.

Execution, knowledge of the plans made, preparations for carrying them out, and carrying out the plans as per schedule.

It is, of course, necessary that these general conditions be harmonized to make an efficient working arrangement. Due consideration must be given to the order and its promise to ship. The facts governing the promise to ship should be investigated before such promise is given.

ANALYZING THE ORDERS.

Every order should be analyzed as follows:

- The patterns and core boxes in accordance with the order, and are they ready for delivery into the foundry?
- Are all necessary flasks and similar equipment avail-

able? If not, how long will it take to have them made?

Therefore, an efficient organization will have an arrangement that will give proper consideration to these two features, availability and the promise to show availability or non-availability and anticipated delivery dates at a glance. It will arrange to have everything pertaining to the work made ready or reasons given why the work is not available. Not only that, but it will have a proper arrangement for checking the work after operations are actually started.

SHOP DETAILS.

The handling of shop details commences upon receipt of orders from customers, and is sub-divided as follows:

- 1.—Their proper numbering.
- 2.—The customer's order must be converted into a work order for office record, for the shop superintendent and for the shipping department.

The copy of the order intended for the shop superintendent should be sent to the dispatching office and the one for the shipper to the pattern house. The dispatching office should give careful consideration to the following:

- 1.—What is being made.
- 2.—What should be made next.
- 3.—What the work to follow necessitates and the order in which it should be made.

For this purpose files should be used to keep the necessary cards in.

The dispatching office should also keep three additional card files for:

- 1.—Current day.
- 2.—Unavailable.
- 3.—Available.

As the orders are received, as shown by the superintendent's copy sent to the dispatching office, this office should make out a card in triplicate for each pattern called for, filing them in the card file marked "Current Day." After this the copy of the order should be forwarded to the proper person. When the report comes from the pattern storage department, designating the patterns which are not laid out, the dispatching office takes the cards from the file, removes the ones listed in the "exception" report and places them in the "unavailable" file, while the ones which are ready for the foundry are placed in the "available" file. As the "unavailable" patterns are made and sent to the pattern storage department the dispatching office will be notified in order that the "unavailable" cards for such patterns may be shifted to the "available" file.

The shipping department should have two files for the following:

- 1.—Work under way in the shop.
- 2.—Castings on hand.

The shipping clerk, upon receipt of the triplicate cards covering work made, files them under "Work under way in the shop." On the day following the completed work, the clerk removes these cards from the file (work under way in the shop), and carries out the following procedure:

a—Weighs the good castings and enters the number and weight on the card.

b—A similar report is made out for rejected castings, designating also the reason for rejection.

c—The cards which designate that the castings are good, that they have passed inspection, are now placed in the "Castings on hand" file.

d—The cards designating rejected castings are forwarded to the accounting office in order that the proper action may be taken. A copy is also sent to the shop

superintendent in order that he may know what castings are lost and why. In case that upon investigation it is found that any rejected work is not the fault of the molder, the rejection card covering such work is marked O. K. and forwarded to the accounting department.

Copies of all rejection cards are also forwarded by the shipping department to the dispatching office, so that work orders may be made out for castings to replace those rejected.

SUMMARY.

It must be understood that the foregoing is a general outline of a system and that it is merely the fundamentals; that minor details have not been explained with the exception of those which are not foreign to ordinary foundry systems. In this connection it might be stated that should the methods as here described be put in practice, that through suggestions which will present themselves the following desired accomplishments will be readily available, namely:

- 1.—What is being worked upon.
- 2.—What is available and what is not.
- 3.—What is to be made next.
- 4.—A record of each employee's work each day.
- 5.—Work in progress.
- 6.—Work at any stage.
- 7.—Work ready for shipment.
- 8.—Planning the work to be done.
- 9.—Promise of shipments.
- 10.—Daily production and production cost.
- 11.—Work to be replaced.
- 12.—Required inspection for work accepted.
- 13.—Amount of rejected work.
- 14.—Individual efficiency basis for bonus.

WEIGHT OF SUBSTANCES DECOMPOSED PER AMPERE HOUR.

Substance.	Formula.	Molecular Weight.	Equivalent Weight.	Grammes decomposed per ampere hour.
Acetic Acid ...	HC ₂ H ₃ O ₂	60	60	2.24
Copper Cyanide...	Cu (CN) ₂	89.6	89.6	3.33
Copper Sulphate	CuSO ₄ .5H ₂ O	249.6	124.8	4.65
Double Cyanide of Copper and Potassium ...	CuCN.KCN	154.6	154.6	5.75
Double Cyanide of Gold and Potassium	AuCN.KCN	288	288	10.72
Double Cyanide of Silver and Potassium ...	AgCN.KCN	199	199	7.42
Ferrous Sulphate	FeSO ₄ .7H ₂ O	278	139	5.18
Gold Chloride...	AuCl ₃	303.5	101.7	3.78
Gold Cyanide...	Au (CN) ₃	223	223	8.31
Hydrochloric Acid	HCl	36.5	36.5	1.36
Nickel Sulphate...	NiSO ₄ .7H ₂ O	281	140.5	5.24
Nitric Acid	HNO ₃	63	63	2.35
Silver Cyanide...	AgCN	134	134	5.00
Silver Nitrate...	AgNO	170	170	6.33
Stannous Chloride	SnCl ₂	189	94.5	3.52
Sulphuric Acid...	H ₂ SO ₄	98	49	1.83
Zinc Sulphate...	ZnSO ₄ .7H ₂ O	287	143.5	5.35

The Ajax Metal Company, Philadelphia, recently opened a branch office in Cleveland, Ohio, located in the Schofield building. Mr. L. E. Purnell is district manager. The Pittsburgh office has been discontinued.

ACTIVITIES OF THE BRITISH INSTITUTE OF METALS

A SUMMARY OF THE FOURTH REPORT OF THE CORROSION COMMITTEE.*

By GUY D. BENGOUGH, M.A., D.Sc., AND O. F. HUDSON, D.Sc.

*The report has been ready for several months but owing to war expedients it could not be made public before this time.—Ed.

The report is divided into three main parts. The first is devoted to the question of the nature of the actions that take place when metals such as zinc, copper, aluminum, and alloys such as 70:30 brass, corrode in neutral or nearly neutral liquids, *e.g.* distilled water and sea-water. The second section is devoted to the consideration of the behavior of condenser tubes in similar liquids, and the variations in behavior in different samples of tubes of nominally the same composition. In the third section an attempt is made to set out in some detail a statement of the practical problems of corrosion, which appear to the authors to be very different from what is usually supposed. A preliminary account is also given of experiments carried out with the object of testing an electrolytic (the Cumberland) process of protection, and a pre-oxidizing process.

PART I.—THE NATURE OF CORROSIVE ACTION.

The current theories of corrosion are briefly considered. The difficulties in the way of making a true quantitative determination of the amount of corrosion are discussed, and shown to be almost insoluble in certain cases with existing methods of analysis. Mere "loss of weight" measurements, unsupported by detailed analysis of scale and metals in solution, are considered to be of little value in many cases, and might be replaced with advantage by microscopic work.

The action of distilled water on metallic zinc has been studied in some detail, and the following conclusions have been reached. Metallic zinc is normally covered with a partially protective scale, which consists largely of oxide or basic carbonate. Water containing CO_2 can attack or dissolve the oxidized layer, and zinc can then be found in solution as a slightly soluble bicarbonate. The attack on the scale begins at certain points, and a true metallic surface is exposed to the action of the water. At such places a peculiar form of oxide is formed on the surface of the metal. Probably this oxide contains zinc peroxide, and exerts a catalytic action on the underlying metal. It is slightly soluble and passes into solution, and is afterwards largely precipitated as the ordinary hydroxide and carbonate. The precipitated hydroxide has a distinctly protective action on the metal beneath it, and reinforces the original scale and enables it to resist the action of CO_2 . The action is thus localized. In the presence of very large amounts of CO_2 , as, for instance, when the water is kept saturated by bubbling CO_2 through it the products of corrosion are largely kept in solution and local action is almost entirely avoided, though the total amount of corrosion that takes place is increased. This is due to the fact that almost the whole of the original scale is removed by the solvent action of the water, with the result that further oxidation of the metal can take place, and further solution.

In the case of very dilute acid, such as acetic, the action consists in the replacement of hydrogen by zinc, but the action is not severely localized as in the case of distilled water; there are no local accumulations of the products of corrosion, and consequently the action is much more nearly uniform. There is no evidence that dissolved oxygen can act as a depolarizer; hydrogen is given off as gas.

The authors come to the conclusion that the initial action of distilled water on zinc is a process of chemical

oxidation rather than electro-chemical displacement.

The action of sea-water on zinc is also chemical rather than electro-chemical, and local action in this case is also due to the local accumulation of the products of corrosion.

The action of distilled water on copper is also chemical oxidation. There is no preliminary electrolytic action, even in the case of a surface of metallic copper known to be free from oxide previous to immersion. The oxide formed over the general surface immediately after immersion is a lower oxide, either Cu_2O or Cu_2O . In course of time it becomes further oxidized at irregularly distributed spots, and the product thus formed does not protect the underlying metal from oxidation to the same extent as does the original tarnish layer. The dark oxidation product itself, which is probably a cupric hydroxide or basic carbonate, tends to flake off the metal, probably owing to the formation of bulky oxidation products beneath it. The latter are porous and apparently amorphous, and probably act catalytically by increasing the rate of oxidation of the underlying metal. The amorphous oxide is slightly soluble, but is finally precipitated from solution as crystalline cuprite, which has a lower solubility than the amorphous oxide. The result of the action, continued in time, is to cause shallow pits in the metal. Such pits are much less important than in the case of zinc. In the case of some further experiments, however, this pitting action was not developed, and the only action that could be observed was the formation of thick layers of oxide over the whole surface of the metal. These layers do not necessarily remain of uniform thickness over the whole surface of the specimen, but pronounced local action does not occur. In rare cases appearances are found on metallic copper, which the authors have only been able to interpret on the assumption that they are little electrolytic cells, but the phenomenon is so rare that it is unimportant in comparison with the main action already described.

The principal action of sea-water on copper is again one of chemical oxidation. The action may be localized by the accumulation of the products of corrosion, under certain conditions.

It has been found that the aeration of one of a pair of copper electrodes causes that electrode to be slightly electro-positive to the other. The effect on the rate of corrosion of the E.M.F. so set up was, however, found to be quite small, and less than the effect of other physical factors, such as the rate of flow of the corroding medium and the degree of aeration. The conclusion has been formed that differences in the rate of oxidation have a greater effect on the amount of corrosion than small differences of potential.

A number of experiments have been made on the effect of coupling together electrodes of different metals, and immersing them in different electrolytes. The behavior of such couples was by no means always such as would be expected from electrode potential lists. In some cases the couple behaved in the reverse way to that which was expected, and in others the effect of the couple in increasing corrosion was much less than expected. The effect of a couple is greatly decreased if the contact between the electrodes is not very carefully made. It is probable that the effect of couples in some of the practical problems of corrosion has been over-emphasized rather than the opposite, as sufficiently good contact for large effect does not usually occur. It has been definitely established that a

metal may be oxidized and pass into solution in spite of the fact that it has been continuously maintained as a cathode, and the laboratory result has been confirmed on the practical scale by experiments carried out with an electrolytic protection of condenser tubes (the Cumberland process).

A preliminary study of aluminum and certain light alloys in distilled water and sea-water has been carried out. Local severe pitting at or near the water-line is described and discussed. It is shown to be due to the presence of a strongly acid salt.

An attempt is made to introduce a definite system of nomenclature into the terms used in the study of the corrosion of binary alloys, in order to avoid the confusion that at present obtains. In certain cases precise definitions cannot yet be formulated, as in the case of 70 : 30 brass, owing to the difficulty of distinguishing between residual metal and redeposited metal.

The nature of the action of distilled water on 70 : 30 brass has been studied in detail by means of the microscope, and analytical methods. The action is considered to be the chemical oxidation of the copper and zinc, and the partial solution of the oxidized products. Most of the zinc passes into solution, in the presence of CO_2 , and part of the copper, the remainder of both metals remaining on the surface of the alloy as an oxide scale. The scale becomes further oxidized and altered at certain spots, which become covered with thick deposits of the products of attack. Such deposits are porous and allow,

and probably accelerate, local attack on the underlying metal. The attack is accompanied by redeposition of copper by displacement by the zinc either electro-chemically or otherwise, and precipitation of cuprite. There are signs of slight local dezincification at such places, but the attack over the general surface of the alloy is complete corrosion. The positions at which local attack and pitting take place are not determined by the variation in the electrical properties of the original metal, but by the conditions of the experiment. In the presence of dilute acids, such as HCl and H_2SO_4 , local action of the type described does not occur, since there is little or no local accumulation of oxidation products. On the other hand, the absence of CO_2 retards the action. From the analytical data it appeared that the local action in the case of distilled water increased with time, while the rate of general corrosion over the whole specimen fell off. These facts suggest the fallacy of loss of weight tests, since local action is more important practically than general corrosion.

The action of sea-water on brass has been studied on the same lines as that of distilled water. The action is considered to be similar in type. Local pitting and dezincification are due to the accumulation of the products of corrosion. Under certain conditions redeposition of copper may occur. The rate of corrosion is much greater than that in distilled water, and does not fall off so rapidly with time. At the ordinary temperature there is less tendency to local dezincification.

(THIS REPORT WILL BE CONTINUED IN THE NOVEMBER ISSUE.)

FOREIGN MELTING PRACTICE

A SIMPLE FURNACE FOR THE SMELTING OF METALS ADAPTED TO BE FIRED BY MEANS OF CRUDE OIL.

One of the main advantages of the furnace consists in the fact that it can be operated with the aid of unskilled labor only. The furnace is built up of the very simplest materials. The outer casing consists of sheets of ingot-iron fastened together so as to form a rectangular box. The height of the furnace may vary, according as it is designed for the reception of small or large crucibles; the furnace shown in the drawings being capable of receiving crucibles having a capacity of from 45 to 90 kilogrammes. The lining consists of refractory stone, the spaces between the lining and the outer casing being filled up with a suitable insulating material, such as sand.

The upper portion of the furnace consists of two cast-iron plates, which rest on a fireproof stone-work ring, and the circular aperture can be closed during the smelting operation by means of a lid or cover. The platform for the workmen consists of plates of sheet-metal which run round the four sides of the furnace, and are supported by angular or U-shaped iron brackets. On this platform there travels also a two-wheeled windlass or lifting mechanism, which is employed to raise the furnace cover, which is flat and circular and composed of stone, and is provided at its center with a small opening, and at its periphery with a stout iron tire. Experience has proved that it is advisable to place the entire structure above the ground, this arrangement dispensing with the necessity for a pit or a special foundation. In the front of the furnace there is arranged a small aperture, usually tightly closed by chamotte, through which any metal that has got into the furnace on account of the accidental breakage of a crucible may be removed.

The space between each pair of furnaces may be utilized for the provision of the necessary pipes for the supply of air and oil, and in order to enable the supply

of these to be properly regulated, there are provided at the inlet a number of valves, by means of which the oil is distributed in the form of a fine jet, so as to obtain a flame capable of completely surrounding the crucible. A small flame will be visible during the operation of the furnace above the opening in the cover.

In consequence of the special shape of the stone which serves as a burner, the oil is sprayed out conically and is ignited when passing in a tangential direction, the flame being consequently caused to move in the annular space between the crucible and the walls of the furnace before it escapes through the central aperture in the fireproof stone cover. As the burner employed, whilst of suitable shape, is of very simple construction, it is impossible for any unused oil to escape and consequently by this means there will be obtained not only a considerable reduction of cost, but the time occupied by the smelting operation will be practically uniform, as it will correspond with that necessary for the complete consumption of the oil within the furnace.

The shape of the oil-burner depends mainly on the kind of compressed air plant employed. When compressed air is already present, it is inadvisable to reduce it in the foundry to less than 1.75 kilogrammes per square centimeter of water pressure at the burner head. A burner employed for a special type of high pressure construction has been found to give very satisfactory results in producing the necessary spraying action in the case of the heaviest crude oils employed, and by its use very important practical advantages may be obtained during the smelting operation. A consumption of, say, 6.75 litres to each 45 kilogrammes of molten brass can be continuously maintained. The fact that the action of the flame of such a high pressure burner on the lining of the furnace and on the crucible is ingenious, and consequently reduces the

life of the crucibles and necessitates a more frequent renewal of the lining, can be set off against the great saving in oil effective.

Very good results have also been obtained with low pressure burners which are employed in foundries, the pressure of whose air supply is not very high. For the simultaneous operation of four furnaces there may be employed small rapidly-rotating electric fans, capable of producing a pressure of from 508 to 558 mm. of water. Care should, however, be taken always to start two cold furnaces simultaneously, and to shut off the air supply of furnaces separately, immediately they are out of use.

The consumption of oil, when adopting this method, is a little more than 9 liters per 45 kilograms of molten metal, the somewhat higher consumption being, however, set off by the fact that 45 kilograms of brass can be smelted and cast in a very uniform manner in a time not exceeding 35 minutes. Charges of 90 kilograms require from 50 to 55 minutes.

Furnaces of this kind, in addition to the fact that they can be operated entirely by unskilled labor, possess the further advantage of being easily transported, and are capable of being erected on any piece of level ground. They can be easily repaired, and are very easily controlled on account of the simplicity of regulation of the air and oil supply valves. The original outlay is low and the cost of repairs forms but an insignificant item. A large number of such furnaces have been operated continuously day and night for over a year, and all the repair required has consisted in the partial renewal of the walls in various places, no relining being required. Their effect on the crucibles is by no means so injurious as that of the furnaces heated by gas, whilst the disadvantageous scorification, unavoidable when coke firing is employed, is entirely obviated. The furnaces require cleaning only when, as the result of using very heavy viscous oils, a deposit of solid carbon has been formed on the wall of the furnace opposite to the burner. This must be removed when the crucibles containing the molten metal are taken out of the furnace in order to effect casting, as if allowed to remain it would interfere with the proper circulation of the heating flame.

Crucibles containing 45 kilograms of metal can easily be removed by hand; those containing 90 kilograms are, however, best moved by means of a windlass or the like, to avoid all risk of accidents.

In a properly managed brass foundry it is, of course, usual to control all mixtures by analyses, and to weigh carefully all charges. By these means it is frequently possible to effect a considerable saving of fresh copper. The following table gives the monthly output of "G" metal:

SMELTED METAL IN POUNDS (0.45 KG.).	
Zinc	65,920
Cartridge-cases	349,813
Waste	1,066,767
Total	1,482,500

Fluxes used	7,412 pounds
Alumina used for purifying...	920 "

FOUNDRY PRODUCTION.	
Number of smelting operations, 14,825, each of 100 pounds.	
Bars produced 124,855 =	1,312,225 pounds
Waste and spilled metal.....	26,539 "
Metal recovered from the foundry waste	73,920 "
	1,412,684 pounds

Loss in smelting, 1,482,500 — 1,412,684 = 69,816 pounds (4.7 per cent.).

Number of furnaces employed: 18 to 22. Total consumption of oil: 146,696 liters. Consumption of oil per 100 pounds (1 pound = 0.45 kilogram) of molten metal, 9.9 liters.—"Geisserei-Zeitung," No. 4.

THE MANUFACTURE OF WHITE METAL SUITABLE FOR BEARINGS.

This process makes use of metals, all of which can be found in Germany, and none of which has up to now been reserved for military purposes, for the production of a high-grade white metal suitable for bearings, this being effected by enriching molten lead with from 3 to 6 per cent. of calcium by submerging pieces of metallic calcium in the molten lead, and then adding to the mass from 1 to 3 per cent. of cadmium and bismuth by dropping them into the molten metal.

When it is not desired to make use of both the cadmium and the bismuth, it is possible to obtain a satisfactory result by employing a correspondingly large percentage of bismuth only, care being taken that the amount of bismuth is large enough to ensure the sufficiently easy flow of the alloy.

ELECTRO-CHEMICAL EQUIVALENTS OF METALS.

Metal.	Chemical Equivalent.	Electro-Chemical Equivalent (Milligrammes).	Grammes deposited per ampere hour.	Ozs. (avoirdupois) per 746 ampere hours.
Aluminum	9	0.0931	0.334	8.8
Antimony	40	0.414	1.09	39.4
Copper (ic)...	31.8	0.329	1.182	31.2
Copper (ous).	63.6	0.658	2.364	62.5
Gold (ic)....	65.7	0.68	2.44
Gold (ous)...	197	2.04	7.35
Iron	28	0.29	1.04	27.4
Lead	103.5	1.07	3.85	101.0
Magnesium ..	12	0.124	0.447	11.8
Mercury (ic).	100	1.035	3.72	98
Mercury (ous)	200	2.07	7.45	196
Nickel	29.35	0.302	1.085	28.6
Silver	108	1.118	4.025
Tin (ic).....	29.5	0.305	1.095	28.9
Tin (ous)....	59	0.61	2.19	57.8
Zinc	32.5	0.336	1.21	32
Hydrogen	1	0.01035	0.0373

WEIGHT AND THICKNESS OF METALS DEPOSITED OR DISSOLVED BY 10 AMPERES PER SQUARE FOOT.

Metal.	Grammes per 10 ampere hours.	Inch thickness per hour with 10 amp. per sq. ft.
Copper (Cyanide)..	23.64	0.001122 = 1/890 approx.
Copper (Sulphate)..	11.82	0.000561 = 1/1780 approx.
Gold (Chloride)...	24.5	0.000535 = 1/8070 approx.
Gold (Cyanide)....	73.5	0.001605 = 1/623 approx.
Iron	10.4	0.000564 = 1/1770 approx.
Lead	38.5	0.001430 = 1/700 approx.
Nickel	10.85	0.000552 = 1/1815 approx.
Silver	40.25	0.001610 = 1/621 approx.
Tin (Stannic).....	10.95	0.000625 = 1/1600 approx.
Tin (Stannous)....	21.9	0.001250 = 1/800 approx.
Zinc	12.1	0.00074 = 1/1350 approx.

NOTE.—The denomination of the fraction shows the number of hours required to obtain a deposit of 1 in. thickness. For example, it requires 890 hours for 1 in. thickness of copper (cyanide) to be deposited with 10 amp. per square foot.

METHODICAL EXPERIMENTAL WORK IN ELECTRO-PLATING

WRITTEN FOR THE METAL INDUSTRY BY JOSEPH HAAS, JR.

PROCEDURE FOR PRACTICAL INVESTIGATIONS INTO PLATERS' DIFFICULTIES.

The object of this paper is to lay emphasis upon the importance of thorough and correct experimental work, not for the storage of knowledge but for its spreading. Many old ideas have been found to be false, and there still exists today much in text books on electroplating that needs investigation and confirmation. Especially is it desirable to carry on experimental work, since the tendency of platers today has been to learn the principles of chemistry which are the basis of electro-plating. Too much emphasis cannot be placed upon thoroughly and correctly understanding those principles, as half learned knowledge is more dangerous than none at all. Nothing else will stimulate thorough research and experiment as a knowledge of chemical and electrical principles. Electro-plating will be based as a profession, then and only then, when the men who practice it will do their work scientifically and above board. "Gum-shoe" methods must disappear if plating is to be considered as a profession.

There exists also much material in journals and reports on pure chemistry in English, German and French, that is worthy of industrial application and consideration, but which no one tries to apply, or at least to disprove. Negative results are just as important as positive ones for they show one of two things; either the process is entirely impossible of practical application, or there has been an error made somewhere in the performance of the work. By giving out the negative result a more clear minded person may detect the error.

The first requisite of experimental work is to have a knowledge of the principles upon which the work depends. The second is good observation and the ability to draw conclusions. Therefore to do experimental work in electro-plating, the principles of chemistry and electricity and their applications are essential. But one must not be blinded by theory so as not to be able to work practically and observe correctly, nor to get nervous or lost if what one expected to happen does not do so, but exactly the opposite occurs. In doing an experiment upon a certain problem, to obtain certain desired results, or to draw conclusions from a series of parallel experiments, it is not only desired but also essential to carry out the experiments as far as possible under constant and similar conditions.

Having a problem to work on, the method of procedure should be as follows:

1. Statement of the problem, e. g., to find the effect of increasing amounts of free cyanide in a brass solution.
2. Then one should make a statement of why he is studying that particular problem.
3. Write all possible chemical equations and note which one you expect to take place.
4. List of possible errors and how each is to be minimized.

Nor should one fail to have on hand the work of the best authors, to consult them and read up the various opinions before proceeding with the experiment. Besides the requisite knowledge to perform experimental work, patience, a quality which is most seriously lacking in platers, is necessary. If a plater does not secure immediate results, his verdict is "No good."

As has been stated, it is not only necessary to have the requisite knowledge, but also the applicability. In the actual performance of an experiment, such dependent factors as concentration, voltage, current density temperature, electrode surface must be handled carefully. If it is desired to experiment with concentrations and

their effects on the fall of potential (voltage), through a cell and the effect on amperage, then the temperature and electrode surface must be kept constant. On the other hand, if it is desired to experiment with area of electrodes, then temperature and concentration become the constant factors; and when temperature is experimented with, concentration and electrode surface are kept constant.

Experimental work is expensive both as regards time and cost of materials. For the plater who is so fixed that he cannot experiment nothing can be done but that he turn his ideas over to someone else to try out for him. For the plater who has both the time and the opportunity if he is working for a firm willing that he should do some experimental work, the cost of material is not great if the plater keeps in view that experimental solutions may be utilized by adding them to the working baths, provided no material has been added that would tend to spoil the solution. As an example; if one were trying to see how much copper must be added to spoil a nickel solution, such a solution, while it could not be added to the nickel solution, could readily be added to an arsenic black nickel solution.

To save the cost of materials, it is advisable to use a small solution in experimenting, but not so small that one cannot draw conclusions as to what the results will be on a large scale. A glass battery jar of six gallons capacity makes a very good experimenting vessel. A glass vessel is desirable because in that way one has an opportunity to observe the interior of the solution, and thereby detect the occurrence of precipitates and the formation of gaseous products. Another point to be remembered is to duplicate working conditions when experimenting, otherwise no conclusion can be reached for the practical duplication. A good plan is to arrange the distance between the anode and cathode the same as under practical working conditions, and then proceed to operate the solution by voltage control. For example, if one is experimenting with a nickel solution, one should remember that over $1\frac{1}{2}$ volts, considerable gas is given off, which, although it does no harm on some classes, may be harmful on other classes of work. Therefore, if the latter is the case, such a solution must be made that will give a soft and close-grained deposit at $1\frac{1}{2}$ volts. The amperage which is desired to be as high as possible, is not so important as the voltage in the effect that it has on the character of the deposit. An experimental solution that gives the desired results can be made up with confidence for a large solution.

The following is suggested as a useful table of data to be observed and recorded when doing preliminary experiments. Heading the experiment should be the four topics that have been given above, and any others that the experimenter deems necessary.

After results have been obtained with the experimental solution, it may be desirable to try it out in a larger solution. This solution should be not less than 25 gallons and should be fitted with a heating arrangement, so that the solution may be tried hot if such was done with the small solution. A cast iron enameled tank is good to use as it will then serve as an experimental tank for either alkaline or slightly acid solutions without fear of contamination. Barrel work is done to such a great extent, that it is desirable, and it is quite easy to make a small barrel, that some experimenting be done with these solutions.

Solution	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Metal, salts per gallon						
Metal, ounces per gallon						
Other ingredients, ounces per gallon						
Temperature of operation						
° Bé.						
Voltage—E						
Amperage—I						
Polarization E'						
Resistance R $R = \frac{E - E'}{I}$						
Conductance $K = \frac{I \text{ (one)}}{R}$						

Below is another table that is to be used under the condition that one is comparing one solution with another to find out relative values.

Metal salts, per gallon	Metal, ounces per gallon	Acidity or alkalinity	Other ingredients, ounces per gallon
Degrees, Baume'	Temperature of operation	Distance between anode and cathode	Voltage E
Amperage I	Polarization E'	Resistance R $R = \frac{E - E'}{I}$	Conductance K $K = \frac{I \text{ (one)}}{R}$
Anode surface	Cathode surface	Anodic C.D.	Cathodic C.D.
Metal theoretically deposited	Metal actually deposited	Cathodic efficiency	Loss of weight of anodes
Anodic efficiency	Character of deposit	Remarks	

It is now necessary to explain how these various topics are determined.

Metal salts per gallon
Other ingredients
Degrees Baumé
Temperature of operation
Distance between anode and cathode

} are self evident.

Metal, ounces per gallon:—is determined by chemical analysis.

Acidity or Alkalinity:—may be expressed in ounces of the material; better in percentage.

Voltage
Amperage
Polarization

} The rheostat is opened and the voltage and amperage are read. By shutting off the rheostat the polarization is read from where it begins steadily to drop.

Resistance:—subtract the polarization voltage from the voltage, and divide by the amperage.

Conductance:—Divide the resistance into the numeral one.

Anode Surface:—This is a delicate matter to determine unless the side toward the side of the tank is stopped off. Unless this is done there surely is electro-chemical action taking place, but not to the same extent as that directly facing the cathode. If stopping off is not done $\frac{3}{4}$ of the total immersed anode surface is taken as the active surface.

Cathode Surface:—made equal to what is considered as the active anode surface.

$$\text{Anodic C. D.: } \frac{\text{Amperage}}{\text{Anode Surface Amperage}}$$

$$\text{Cathodic C. D.: } \frac{\text{Cathode Surface}}{\text{Cathode Surface}}$$

Metal Theoretically Deposited:—In determining this factor, it is best not to run the determination less than an hour for the sake of convenience. This factor is determined by multiplying together the number of amperes passing through the solution, the electro-chemical equivalent or the number of ounces deposited in one hour, and the number of hours the determination is run,

$$\text{Weight} = \text{amperes} \times \text{E. C. E.} \times \text{hours.}$$

In this case it is not advisable to take the reading of the ammeter as a guarantee of the number of amperes that are passing through the solution, as there is bound to be fluctuation in the ammeter reading, throwing the results far off. It is better to connect in series with the solution experimented with, a copper voltmeter, of one gallon capacity. This solution is composed of:—

Copper sulphate..... 15 ounces
Sulphuric Acid..... 2 ounces
Alcohol 2 ounces
Water 1 gallon

A copper cathode is first weighed and then placed into the copper solution, and after the experiment is concluded it is removed, rinsed in water, alcohol and dried, and then reweighed to determine the amount of copper deposited. The number of amperes that passed through the copper solution and consequently through the experimental solution is gotten as follows:

$$I = \frac{\text{weight of copper deposited}}{0.0418 \times \text{hours.}}$$

The electro-chemical equivalent is gotten from chemical handbooks or may also be found in Barcleys and Hainsworth *Principles of Electro-Plating*.

Metal Actually Deposited:—The cathode plates are weighed before commencing the experiment and after

the end of the determination they are rinsed, dried and weighed. The difference between the first and second weighings is the amount of metal deposited.

Cathodic Efficiency:—

$$\frac{\text{Metal actually deposited}}{\text{Metal theoretically deposited}} \times 100$$

Loss of Weight of Anodes:—The anodes are weighed before and after the experiment.

Anodic Efficiency:—It must be remembered that the metal that should be dissolved off the anodes should be numerically equal to the amount that should have been theoretically deposited. Therefore:—

$$\text{Anode Efficiency} = \frac{\text{Metal actually dissolved}}{\text{Metal theoretically dissolved}} \times 100$$

Character of Deposit:—What constitutes a suitable deposit is a matter that depends on circumstances. Some will say that so long as it has a good color, buffs easy,

and does not peel, the deposit is satisfactory. Beside the above qualities others will desire that it stand a certain amount of wear. Others will desire that it stand stamping, bending, stretching or compressing. So what will constitute a suitable deposit will have to be decided by the plater himself, according to the demand that his employer places upon him.

Errors in experimental work are greatly possible. One may make errors due to the apparatus of measurement, or to the method of proceeding with the experiment. But the greatest error that one is most likely to make is lack of vision. That is, one works upon a "hunch," and his enthusiasm carries him so far that his observation is hindered, and some of the most vital points may be brought out and pass unobserved, because the experimenter has allowed an idea or theory to blind him. This is greatly minimized when he arranges a plan of procedure to work with and keeps a systematic record of all his observations.

THE FINISHING OF METAL ARTICLES

AN ARTICLE SHOWING THE IMPORTANCE OF CARE IN THE FINAL OPERATIONS OF PRODUCTION.

WRITTEN FOR THE METAL INDUSTRY BY GEORGE P. BUTLER.

He was a gregarious soul. I met him in the smoking compartment of the Southwestern Limited, pulling out of Cleveland for St. Louis. His card indicated he was an efficiency engineer. I knew him by reputation. Had heard him spoken of as the "Best metal finisher in the country." I told him I was much interested in the finishing of metal goods, and would be glad to have his views on the subject. "Yes," he began with a reminiscent smile, "I have had some experience in the finishing of metal goods, both iron and metals. Few manufacturers understand the importance the finish of an article bears to its sale. A very small percentage indeed of the people who make purchases in our jeweler or hardware stores have any knowledge of what the goods are made of. To them they are gold, silver, nickel, brass, copper, aluminum, etc. I have frequently noticed ladies when purchasing tableware, the selection is always made because of the novelty of pattern and superiority of finish. The finish of an article always appeals to women purchasers. The other day while in a hardware store a lady came in and asked to see some meat choppers. Samples of two manufacturers were shown her; both were XC finish; one had a clean bright lustre and the other was yellow, and a "hard case" to look at. It was finished in dirty overheated tin, and although it was the better made article of the two, the lady choose the one with the bright finish.

Big jobbing houses accumulate quantities of goods returned by the trade because they are unsalable, on account of tarnish on brass and copper articles that never had a lacquer dip, this is especially true of brass and copper deposited on iron and steel, and when the jobber takes inventory he has a distressing habit of returning this stuff to the manufacturer.

For some years previous to the start of the war in 1914 our markets were glutted with German made goods of every description, and the domestic manufacturer had some excuse for sending his goods in a poorly finished condition. The situation has changed. German-made goods have disappeared and our trade is again in the hands of the domestic manufacturer. But the jobber and retail dealers must figure on their "turnover" and to continue conditions that existed previous to 1914 is unthinkable; they are demanding that the articles they

handle must have the best possible finish. Their slogan today is: "It's the finish makes the sale. The finish is everything."

The word "efficiency" has been much in evidence the past two or three years, as applied to the manufacturing business; it is very much misunderstood. Efficiency is not maximum. Last summer I was taken through a big plant at Buffalo by the company's efficiency man. He pointed out numerous instances where he had increased the output by his efficiency methods. We examined the work going through the polishing, buffing, plating and japanning departments and found it to be high grade. We finally reached the finished stock and shipping department. Here the situation was changed; boxes containing the finished goods were piled up exposed to dust, and there was lots of it. Not even paper spread over them for partial protection. Girls were wrapping articles that should have been wiped off or returned to the buffing room. A man had dumped a large box of finished japanned small ware on the floor and was using a shovel to put them on the wrapping bench. This concern interpreted efficiency as maximum. Perhaps it was—as far as the shipping room. Right here at the last operation the whole system fell down. Gone was the company's trade mark, "Best Made, Best Finished." Gone were its promises and guarantees to jobber and dealer.

No, efficiency is not maximum; efficiency in manufacturing is co-operation. Permit me to illustrate again: I personally know a man who took charge of the packing and shipping department of a concern making automobile accessories; he laid down a rule that no defective work should leave the factory. For some time his tribulations were many, the foremen knocked him, the office called him down for delaying much needed shipments, but he persisted and established a system of mutual co-operation with the plant foremen, and in time the testimony of the salesmen and letters from the trade convinced the management that the old system of "Let 'em go, they are good enough," was all wrong and the new man was "backed up" to the limit.

"The human side of the industrial proposition is the one great thing, and to attain success we must plan to put it over."

EQUIPMENT

NEW AND USEFUL DEVICES, MACHINERY AND SUPPLIES OF INTEREST

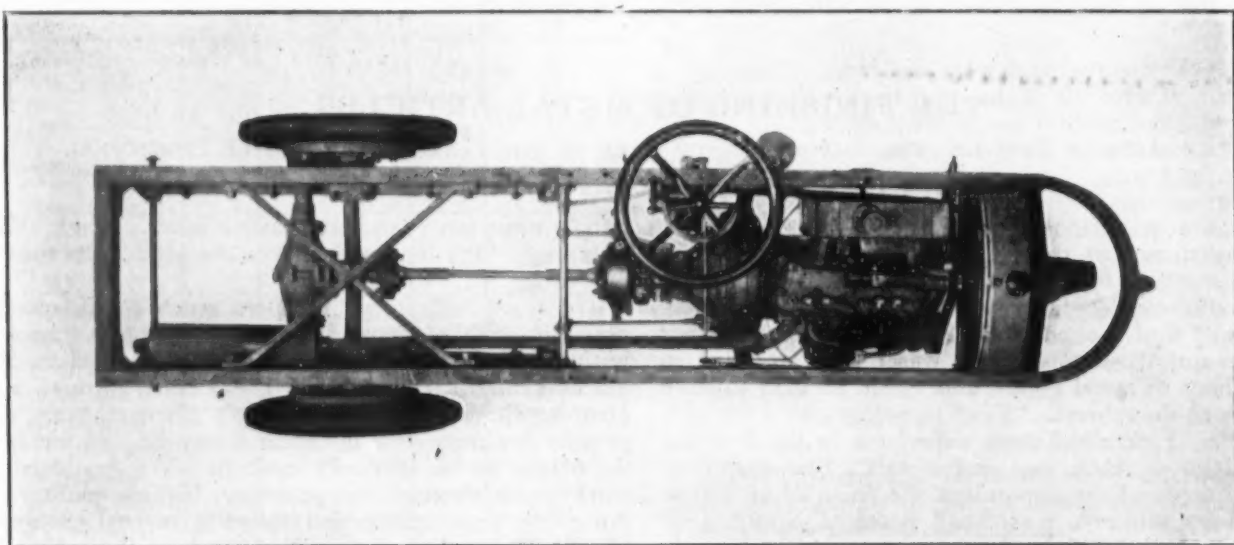
CLARK TRUCTRACTOR

The task of hauling tram cars loaded with coal or ore is being modernized through the use of such a unique device as the CLARK TRUCTRACTOR. This powerful gasoline operated power plant can be adapted to narrow gauge railways with special flanged traction wheels and coupling for hauling loaded cars or trailers. Its wide range of mining operations, its flexibility makes it useful for hauling loads from the camp to the shaft, between machine shop and power house—or wherever loads must be hauled over rough roads and under difficult conditions.

It has been performing many important tasks in a number of

quickly and without damage to the machine. It thus speeds up production, prevents congestion and increases the efficiency of these plants. It has a surprising drawbar pull and is capable of moving loaded freight cars without straining any of its parts. Heavy trailers are transported from one part of the plant to another at high or low speeds, ranging from $\frac{1}{4}$ mile per hour to 15 miles per hour.

The Clark Tructractor has a carrying capacity of one and a half tons, is supplied with either platform, cargo or dump body type. The cargo type sells at \$1,135.00 f. o. b. factory and the dump body type for \$1,210.00. The Clark Tructractor Company, Chicago, Ill., will gladly mail a copy of their new photographic catalog to any one interested.



A PLAN VIEW OF THE CHASSIS

large plants for the past year and a half—moving freight cars, heavily loaded trailers and carrying loads up to a ton and a half constantly—day after day—without breakage or mechanical troubles. The fact that it operates on 3 gallons of gasoline ordinary working day, makes it a most economical machine.

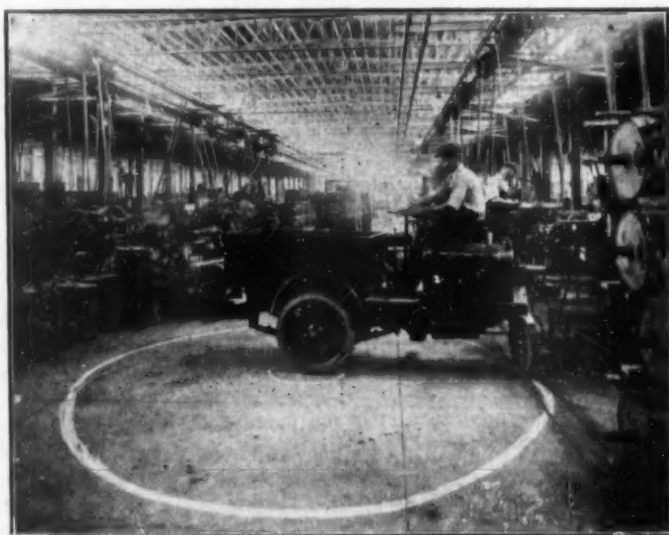
Its ability to run 24 hours a day without being laid up for recharging and its economical operation, coupled with the lack of breakage, makes this machine an exceptionally efficient and satisfactory one for commercial purposes.

Nine and one-half inches of ground clearance and an abundance of power, make it possible for the Clark Tructractor to manipulate on rough ground, foundry floors, factory yards and bad roads. Sand and mud do not prevent this machine from successfully and quickly performing its duties under all weather and factory conditions.

Its range of speed (from $\frac{1}{2}$ of a mile to 15 miles per hour) permits the Clark Tructractor to creep through congested places and around sharp corners, deliver its load exactly in the place desired, without danger to machinery or employees, and to run at high speed through open places and in the traffic of roads and city streets.

One of the machines was recently driven from Buchanan, Michigan, to Chicago, Illinois. This machine was stopped at several of the large industrial plants on the way and most interesting demonstrations were held. It covered a distance of 143 miles in one day and arrived in Chicago in first class condition, ready to begin regular routine work in one of the well-known institutions.

The fact that this machine is built entirely of metal and that its center of gravity is very low, makes it a most satisfactory one for foundry and forge shop use. Extreme changes in temperature do not affect its operation. Hot castings and forgings can be carried from one section of the plant to the other



TURNING ON A WHEEL BASE RADIUS

Owing to the printers' strike in New York City, our equipment pages in this issue are not complete.

We will make up the deficiency in future issues.

ZINC OPENS NEW AVENUES

With the utility of rolled zinc an accepted fact, many opportunities for reducing costs are presented in various manufacturing lines by its substitution for certain other metals. Aggressive purchasing agents, therefore, have an avenue opened to them for being greater factors in cutting corners for their concerns.

This metal embodies essential qualities that commend it for extensive use in the production of a wide field of commodities. For instance, under ordinary weather conditions, zinc is non-corrosive, obviously an advantage. The peculiarly high grade manufactured by the New Jersey Zinc Company, of New York, can be easily drawn or spun, a fact that should not be overlooked.

The reason for the easy working qualities of the New Jersey zinc lies in the high purity of its ores. These come from its mine at Franklin, New Jersey, and are recognized as producing zinc that contains none of those deleterious impurities that otherwise might militate against economical operation of the rolled metal.

The fact that this zinc is declared to be practically the only non-ferrous metal that does not require annealing during forming is another feature in its favor, for this automatically reduces by at least one (usually more) the necessary operations in making various commodities. This certainly will be a convincing factor in these days of advancing wages and labor shortage.

Although the largest tonnage of rolled zinc in Europe is for roofing, cornices, architectural ornaments, gutters, leaders and flashing, etc., the use of this metal for these commodities in the United States, is, as yet, comparatively negligible. However, zinc possesses a distinct advantage over galvanized iron or tin plate for these purposes owing to its greater durability. Moreover, with the use of zinc, painting is unnecessary unless for purely decorative purposes. (1) In the few cases where zinc roofs have been used in this country they still remain in good condition after 40 or 50 years of wear, though entirely unpainted, and irrespective of the locality (coast or inland), while in Europe they have endured for much longer periods.

(2) Among the numerous uses for which zinc has been demonstrated a practicable metal are mentioned the following: Addressing machines and plates, advertising novelties, alarm clocks, architectural ornaments, badges, pipe covering bands, batteries, boiler plates, bottle covers, buttons, cameras, checks, cases and case linings, mail chutes, cosmetic containers, cornices, electric appliances, eyelets, corset stay tips, flashings, gutters, leaders, fruit jar tops, pencil guards, heel plates, humidors, license plates, meter cases, roofing refrigerator linings, reflectors, share roller tips, weather strips, and many others.

(3) Zinc performs many important functions for the benefit of mankind. Being non-corrosive, it makes a very satisfactory metal for outside use and its durability commends it as a material in commodities where high quality is desired.

Rollled zinc embodies characteristics known to no other material for making stencils, and stencils find a very extensive commercial use. This is the statement made by Mr. William L. Buehler, of the Patent Die and Stencil Works, New York City.

In view of this concern's wide experience in making stencils, the opinion of its representative is regarded as important to the industry.

"Not only is zinc the only material that does not stretch and buckle in continuous use, but it has several other important advantages," says Mr. Buehler. "The oil board used up to now for stencils certainly is low in price but the cutting and making of a paper stencil involves the same skilled work as a stencil made of zinc and while the former hardly will give 20 to 25 impressions or reproductions, a zinc stencil will reproduce 10,000 copies.

"Zinc retains its flat shape indefinitely. Another feature that recommends zinc's use is the low cost of producing the finished stencil, this metal possessing qualities that permit stamping as many as 1,000 stencils in one operation.

"When the manufacturer realizes the economy and value of zinc stencils, as compared with others, it will mean vastly

increased demand for this metal. Stencils form the background of nearly every manufactured article from laces to show cases.

"Right now negotiations are being carried on to supply Japanese producers with zinc stencils for use in stamping silk designs to replace the slower and more expensive hand methods now in vogue.

AMERICAN BUREAU OF SHIPPING APPROVES THERMIT WELDING FOR MARINE REPAIRS

An important development of Thermit welding in American shipyards is anticipated by the recent approval by the American Bureau of Shipping of the Thermit process for welding stern frames, rudder frames, and other heavy sections on ships registered under their classification. The only qualification is that this Bureau be notified sufficiently in advance to have a surveyor in attendance during the welding operation, as well as to inspect and test the weld when completed.

While the Thermit process has been used since 1903 for making marine repairs and has a great many successful welds of this nature to its credit, the process was never officially approved by the American Bureau of Shipping and most of the repairs were made on vessels not classed by them. It is due entirely to the unbroken record of successful marine welds that the Bureau now accords its official sanction to the process. According to a statement by the Metal & Thermit Corporation there has never been a single failure of a Thermit marine weld so far as it has been able to ascertain in all the years that the process has been used under this company's jurisdiction.

Now that the United States promises to have one of the largest mercantile marines in the world, and as practically all of the ships which have recently been constructed, and which will be constructed in the future, will be registered with the American Bureau of Shipping, the recognition of the Thermit process by that Bureau bids fair to result in many important Thermit marine welds from now on.

FOREIGN TRADE OPPORTUNITIES

Reserved addresses may be obtained from the Bureau and its district and cooperative offices upon request by opportunity number. The Bureau does not furnish credit ratings or assume responsibility as to the standing of foreign inquirers; the usual precautions should be taken in all cases. Symbols: * Reported by American consular offices; † Reported by commercial attachés and trade commissioners; ‡ Direct inquiries received by the Bureau.

30,560.—A mechanical engineer in Italy desires to secure an agency for sale of builders' and general hardware, tools, **metals**, mechanical goods, office and other furniture, and provisions. Correspondence should be in Italian. References.

30,556.*—An agency is desired by a man in Italy for the sale of agricultural and general machinery, tools, **metals**, electrical supplies, cloth, and yarn. Correspondence may be in English. References.

30,645.†—An agency is desired by a merchant in Czechoslovakia for the sale of machinery, **metals**, steel tools, mineral oils, chemicals, and general merchandise. Correspondence should be in Polish.

30,583.†—A firm in China desires to purchase and secure an agency for the sale of canned goods, condensed milk, stationery, news print paper, old newspapers, wire nails, **metals**, new and scrap piece goods, and cotton and woolen textiles. Reference.

30,588.*—A company in China desires to purchase machinery and parts of machinery, rice mills, drills, air pumps, bellows and forges, crank shafts, emery wheels, **crucibles for melting brass**, chain blocks, air gauges, belting, engines for motor boats, dynamos, magnetos, motors, nonfriction metals, pig iron and tools. The dynamos and magnetos are needed for immediate use. Quotations should be given c. i. f. Hong-kong. Terms, cash against documents. References.

30,684.†—Prices and illustrated catalogues are desired by a man in Czechoslovakia, of machinery for pressing and manufacturing lead pipes, and also tin-lined lead pipes.

SHOP PROBLEMS

IN THIS DEPARTMENT WE ANSWER QUESTIONS RELATING TO SHOP PRACTICE

ASSOCIATE EDITORS: JESSE L. JONES, Metallurgical

PETER W. BLAIR, Mechanical

CHARLES H. PROCTOR, Plating-Chemical

CASTING

Q.—For the last few months it has seemed impossible for us to get anything but "spongy" castings. We have had more in the last six months than in the previous ten years. We are making about the same grade of brass and melting under the same conditions, except that we are using by-product coke where we used to use 72-hour beehive (Powellton). We sometimes get some copper, of course, which is not just right, but I cannot attribute all troubles to this. Would too much sulphur cause this condition? If so, what should be the sulphur limit we could use?

A.—Sulphur is used in copper-lead alloys (to the amount of one per cent or more) to prevent segregation of the lead. It does this by causing the molten alloy to set quickly, thus enmeshing the lead before it can separate. However, when any scrap from this alloy gets into a mixture containing zinc, trouble from spongy castings may be expected. High sulphur coke will cause similar trouble. The sulphur in the coke oxidizes to sulphurous acid. This is a gas which is absorbed by molten brass during the melting operation and then given off during the solidification of the castings, causing the trouble you mention.

You can specify that your coke must not contain more than one per cent of sulphur. It is possible to obtain coke with sulphur as low as one-half of one per cent. Low sulphur cokes, however, especially those from West Virginia, are liable to be rather light, so that double the usual amount may be required for heat. Further, the low sulphur cokes often have an ash of low fusibility, which melts on the grate bars of the furnace thus impeding the draft.

It is claimed that any amount of sulphur in a brass casting over 0.05 per cent will make it porous. This is probably not true of the leaded bronzes.

Where trouble is apprehended in brass castings from high sulphur, about four ounces of 30 per cent manganese copper may be added to each 100 pounds of brass. The sulphur is removed in the slag as manganese sulphide. It is well to avoid an excess of manganese, however.—J. L. J. Problem 2,743.

Q.—We are having difficulty in expanding fire-hose couplings. These castings appear to be all right when first made, but after a period of a few months they crack under expansion. Our mixture is 89 copper, 5 zinc, 4½ lead, 1½ tin. Can you tell us how to overcome our trouble?

A.—The alloy that you are using has considerable ductility, but it would be much improved in this respect if the lead were not allowed to exceed 3 per cent. The following mixture is recommended:

Copper	90 %
Zinc	6 %
Lead	2½%
Tin	1½%

The source of your trouble is most likely the turnings you use. Turnings when melted offer such a large amount of surface to the air that the resulting metal is drossy and lacking in ductility. You can satisfy yourself of this by running down the turnings separately and noticing the number of bad castings obtained when all turnings ingot is used. The turnings can be used in some other mixtures where they will do no harm. The gates and heavy scrap ought to be satisfactory for remelting.

The slight change in the mixture that is recommended, together with the omission of the turnings, should remedy the trouble you mention.—J. L. J. Problem 2,744.

Q.—Please favor us with a core mixture for heavy bronze and brass castings which will prevent metal from cutting or burning into the core.

We often have calls for castings which have from 2 to 4 inches of metal surrounding the core which in some cases are as small as 2 inches in diameter.

A.—The amount of heat and the intensity of heat stored up

in molten brass is not fully realized by most brass foundries. Careful measurement by pyrometers has shown that brass is frequently poured at 2,500 deg. Fahr. Inferior core sands are partly fused by such high temperature, and when such sands are used for cores the metal penetrates them so that their removal from castings is difficult and even impossible.

The use of a sand high in silica, bonded with core oil, furnishes a core that has the heat resisting qualities required by the most exacting conditions. Such cores can be given a coating of silica flour in order to densify their surface and make them smoother. Cores of this kind are also very free venting, and they stand up when the metal is poured and are easily removed from the castings. Where castings are light, or the metal is poured at a low temperature, such a refractory core sand is not needed and a much inferior grade can often be used with success. Refractory core sands are known as flint or silica sands. They frequently analyze 98 to 99 per cent pure silica, although those of 93 to 95 per cent are satisfactory for brass castings. The purer sands are more commonly used for cores for steel castings and for grinding into silica flour.—J. L. J. Problem 2,745.

Q.—I have quite a number of regulator valves to make for government use, which range from 5 to 7 pounds each. The walls are about 3/16 inch thick; they have to stand a 3,000 pound cold water test, and must be made of composition G. 88—10—2. The valves are spongy and leak.

A.—The 88—10—2 alloy is a rather difficult one to handle in the brass foundry. From the standpoint of valve making, it is liable to suffer from two very serious defects: first, the presence of oxide, dross, or segregated areas; and, second, a coarsely crystalline structure of the castings, which may withstand low pressures all right, but leak or sweat at high pressures. When making the alloys, select the very best grades of copper, tin and zinc. Melt the copper as rapidly as possible and raise to high temperature. Next add the zinc, plunging it to the bottom of the crucible by means of a pair of tongs. Allow to stand for a short time so that the copper may be well deoxidized. Next add the tin gradually, stirring diligently. Keep well covered with charcoal at all times. Remelting after pouring into ingots gives a better alloyed metal. The above precautions ought to give a clean alloy, free from dross and dirt. The granular carbon resistor electric furnace is an ideal way of melting, as it prevents oxidation and gives an unusually clean metal. One maker of difficult 88—10—2 castings says that since he has installed one of these furnaces he has had no worries about the quality of his castings.

If poured too hot, especially if the walls are thick, 88—10—2 valve castings have a coarse grain and they will leak under heavy pressures, although apparently sound. By pouring at about 1,200 deg. C. and using a pyrometer to assure the temperature, a dense, close-grained metal can be obtained.

If permission to use from ½ to 1 per cent of lead in the mixture can be obtained, the castings will be stronger and have a closer grain. An added advantage of this small admixture of lead will be that machining will be greatly facilitated.—J. L. J. Problem 2,746.

CLEANING

Q.—We have from time to time a number of hard metal coffee pots that require silver soldering and find difficulty in getting the article free from all the soft solder on the inside, applied by some inexperienced person who could not do hard soldering. Is there no way that we can eat this soft solder out by an acid process?

A.—Soft solder is a difficult proposition to remove from a finished article. Acids cannot be used especially inside of a coffee pot owing to the action upon the metal that the pot is

made up of. We would suggest that a fairly strong solution of Caustic Soda 74 per cent. to 76 per cent. be made up on the basis of one pound per gallon of water. More if necessary.

Some of the solution should be placed in the pot and then heat the same to the boiling point and maintain at that temperature for some time. The solder should be reduced in solution.

A blue flame is preferable for boiling purposes as outlined. The bottom of the pot should be protected from the flame by a piece of asbestos paper.—C. H. P. Problem 2,747.

DIPPING

Q.—Will you kindly give me some information as to the best way of dip brazing steel parts assembled, made up of $\frac{7}{8}$ " and $\frac{3}{4}$ " seamless tubes joined at right angles?

1. Must a crucible be used?
2. What kind of spelter?
3. What kind of flux?
4. What kind of fuel? (Gas or crude oil.)
5. Must the parts be freeheated and flux put on before dipping?
6. What is the best way of, or method to clean off the borax after brazing?

A. Attempts have been made to use steel, nichrome and various other kinds of metal brazing pots but the molten brazing solder being at a temperature of 1600 deg. Fahr. or higher, dissolves varying amounts of the iron, nickel and what not, becoming itself drossy and sluggish. Hence graphite pots even if they only have a life of a few weeks, are to be preferred. They do not contaminate the spelter.

The spelter generally used for brazing is 50 per cent copper and 50 per cent zinc. This metal is brittle hence a 55 per cent copper and 45 per cent zinc mixture is preferred by many as it has a little ductility and its melting point is not appreciably higher. A spelter containing 85 per cent copper and 15 per cent zinc gives a very strong joint, but on account of its high melting point, has to be applied by the acetylene torch. Tin up to 5 per cent and aluminum up to 1/10 per cent added to spelter to reduce its melting point and make it flow better, especially in brazing brass or copper. Borax is generally used as a flux and because tin and aluminum do not form borates or in other words because tin and aluminum oxides do not dissolve in the borax, these additions are not thought desirable. They do give fluidity and where the brazing is done with little oxidizing, they may be used if desired.

Borax made into a thin paste with water is the flux commonly used. Borax contains a large amount of water of crystallization.

This causes foaming and loss of the flux. Hence boracic acid is much preferred by many as it melts down quietly.

Oil is preferred as a fuel for it is more uniform in composition than natural gas. By maintaining a neutral or slightly reducing atmosphere around the crucibles their life is increased.

Preheating and putting on the flux before dipping is desirable. A hot solution of soda ash is recommended for removing the excess of borax. It is a common fault to use too much borax. Only use just enough to do the work and then the amount to be removed will be small. The sand blast is a satisfactory method of removing excess flux or any scale that is formed. Small pneumatic chisels and small emery wheels mounted on flexible shafts will be found more expeditious than filing when excess spelter is to be removed.—J. L. J. Problem 2,748.

Q.—We are interested in dip solution for 22kt. gold to be used prior to putting on a final mirror finish to same.

A.—We do not believe a 22 karat dip gold solution would prove satisfactory for your purpose, because only a very thin deposit of gold can be obtained. An electro gilding solution would be preferable. You can put any thickness of gold desired upon the articles to be plated with the electro solution. However, we give you both types of solution.

IMMERSION OR DIP SOLUTION

Water	1 gal.
Yellow Prussiate of Soda.....	6 ozs.
Sodium Cyanide	$\frac{1}{2}$ "
Phosphate of Soda.....	2 "
Soda Ash 58 per cent.....	2 "
Sulphate of Soda.....	1 "
Gold Trisalut	$\frac{1}{8}$ "

Use an iron kettle un-enamelled. Heat to 160 to 180 degrees Fahrenheit.

If gold chloride is used in place gold trisalut, then $\frac{1}{4}$ oz. of gold chloride and 1 oz. sodium cyanide will be required. Replenish with gold trisalut or gold chloride and sodium cyanide in proportions given.

ELECTRO GOLD SOLUTION

Water	1 gal.
Sodium Cyanide	$\frac{1}{4}$ oz.
Gold Trisalut	$\frac{1}{8}$ "
Bisulphite of Soda.....	$\frac{1}{8}$ "
Phosphate of Soda.....	$\frac{1}{4}$ "

Temperature 160 to 180 deg. Fahr. Voltage $2\frac{1}{2}$.

Two dry cells will give the voltage if connected in series. A storage battery yielding $2\frac{1}{2}$ to 3 volts may be used.

If gold chloride is used in the place of gold trisalut, then $\frac{1}{8}$ oz. chloride should be used and $1\frac{1}{4}$ to $1\frac{1}{2}$ ozs. sodium cyanide.

Anodes of 22 karat gold should be used in the electro solution. The dip or immersion solution requires no anodes.—C. H. P. Problem 2,749.

PLATING

Q.—We are plating hooks and eyes. Our present method is to hang a sheet or bar of tin in a solution of cream of tartar and water. We then throw the hooks and eyes into the bath and after a short time remove them. The difficulty is that after a few days the plating turns yellowish. Our intention is to silverplate the hooks and eyes. Can this be done in a similar fashion, or would it be best to use regular electroplating methods? Also, what would be the best formula for a bath of each method?

A.—From the information received the amount of tin deposited upon the hooks and eyes you manufacture must be infinitesimal, otherwise they would not turn yellow as you note. Do you use brass wire in their manufacture?

In tin plating by the boiling cream of tartar solution method a saturated solution of cream of tartar must be used. Maximum, two pounds per gallon. The articles to be tinned should be placed between thick sheets of perforated Straits Tin, say about two inches in depth of materials. The boiling should be continued for at least five hours at a low boil when ample tin should have been deposited.

The articles so tinned should be carefully washed in clean, cold and boiling water and then tumbled for a short time in Hot Maple Sawdust.

It is an advantage to use about 1 oz. of Black Platers' compound per gallon of boiling water. The compound will assist in drying out the articles as the water will run away from them more readily.—C. H. P. Problem 2,750.

Q.—I am manufacturing a product of iron which I wish to gild. I would like information as to whether to use a dip gold solution or regular electroplating bath. Also please give formulae.

A.—We presume the articles to be gilded are made from steel; if iron, the manipulations are the same.

The parts to be gilded should be polished and cleansed as usual, depending upon the final finish and then plated in a brass solution to obtain a light basis brass deposit. The solution for this purpose should consist of:

Water 1 gallon.
Sodium Cyanide 5 ozs.
Copper Cyanide, $3\frac{1}{2}$ ozs.
Zinc Cyanide $1\frac{1}{4}$ ozs.
Soda Ash 1 oz.
Sal Ammoniac $1\frac{1}{3}$ oz.
Temperature 80 deg. Fahr.
3 to $3\frac{1}{2}$ volts.

After brass plating for a few minutes remove from solution, wash in water, scratch brush if for dull finish or polish lightly for lustre, then recleanse and gild in a solution composed as follows:

Water 1 gallon.
Gold Trisalut $\frac{1}{2}$ oz.
Sodium Cyanide $\frac{1}{4}$ oz.
Phosphate Soda $\frac{1}{4}$ oz.

Temperature 180 deg. Fahr.

Volt 2 to 2½.

Use Gold Anodes 22-24 karat.

After gilding, wash and dry carefully and finish as usual.

—C. H. P. Problem 2,749.

Q.—The writer would be very glad to have your opinion on the following, in connection with zinc-plating with a sulphate solution in barrels.

1. What is the minimum desirable thickness of zinc coating for small parts used on automobile rims such as bolts, nuts, wedges, etc., expressed in ounces per square foot?

2. What is the most efficient current density, the bath being kept at room temperature, 60 to 70 deg. Fahr?

3. Would a lower current density have any effect other than to increase the time necessary for the desired thickness of plating?

4. Is there any particular advantage in using a sulphate rather than a cyanide solution in barrel plating?

A.—1—The minimum desirable thickness of zinc deposited from an acid or alkaline solution should be not less than ¼ oz. of zinc per square foot of surface. For wearing qualities and protection against corrosion this thickness of deposit will withstand the Preece test of three one-minute immersions in a concentrated acid free solution of copper sulphate.

2—The current efficiency depends largely upon the composition and metal content of the solution. A very efficient sulphate zinc solution will not carry a current density in excess of 10 amperes per square foot of surface. An efficient zinc cyanide solution will allow 25 amperes.

3—Lower current densities are effective in producing a finer texture of deposit free from crystallization or in other words an excess porous deposit. Lower current densities, however, require increased time of deposit. Ten amperes would give a thickness of deposit in 15 minutes that would require 30 minutes at 5 amperes under the same solution conditions.

4—There is no advantage in using a sulphate zinc solution in barrel plating rather than a cyanide solution except in plating gray iron which apparently produces polarization in solution due to the fact that a primary battery is set up in the solution due to the composition of the solution by its local action upon the cast iron. However, zinc cyanide solution for barrel plating should be fairly concentrated 6 to 10 ozs. metal per gallon of solution. The speed of rotation of the barrel should also be low not to exceed 3 to 4 revolutions per minute.—C. H. P. Problem 2,746.

Q.—My work in the white nickel solution has been coming out too dark. My solution is composed of double and single nickel salts, boric acid and common table salt. The voltage is 4½. The solution is made up in a None-Such plating machine and I run my work for about thirty or thirty-five minutes. The result of this is a dark finish. I would appreciate it greatly if you could help me in any way to get a lighter and whiter finish.

A.—We should judge that your trouble is lack of metal in the solution and advise the addition of about four ounces of single nickel salts per gallon. It is possible that the solution may be alkaline due to the addition of common salt. If so, the addition of a quarter ounce of sulphuric acid per gallon of solution dissolved in sufficient cold water will overcome the alkalinity, and produce a brighter polish.

A nickel solution should always show a slight acid reaction. Magnesium Sulphate or common Epsom Salt is a factor in producing a bright deposit. Add a half ounce per gallon or upward. Although common salt is a splendid conductor for a nickel solution, sal ammoniac will give more efficient results.—C. H. P. Problem 2,744.

SILVERING

Q.—We intend manufacturing a glass knob spindle and are in doubt more or less about the process of silvering the small end of the glass knob itself.

We are wondering if you have any data or any information of your own which would enlighten us as to the method employed.

The idea of silvering is to bring out the figure of the knob as you can easily see on examining any glass knob set.

A.—In reply to your letter we give below a formula that is recommended for silvering glass and which we believe will answer your purpose.

Nitrate of silver.....	1 ounce
Distilled water	3 ounces
Alcohol	3 ounces
Ammonia	about 1 ounce
Grape Sugar	2 ounces

Dissolve the nitrate of silver in the water, add the ammonia in a quantity just sufficient to redissolve the precipitate formed at first, add the alcohol, and allow it to rest for four or five hours. The grape sugar is dissolved separately in 1 ounce of water and added to the silver solution at the moment of using.—C. H. P. Problem 2,743.

TEMPERING

Q.—We are using large amounts of heavy and light flat forming tools for machining brass and having considerable trouble with them warping and a rough scale forming on the surface.

A.—The trouble you are experiencing is caused by the high temperature you are employing to get the desired hardness required for these tools to machine brass at a high rate of speed. Take two cups of water, ½ cup wheat flour, 1 cup salt. Mix these into a paste and when a piece of steel which it is desired to harden is sufficiently hot to make the mixture stick to it dip it into the mixture. Heat the steel to a cherry red and plunge at once into a soft water, holding the forming tool in a straight vertical position. If properly done the tool will emerge with a beautiful white smooth surface and will be the correct hardness.—P. J. B. Problem 2,752.

CORRECTION

The following is a correction of the solution to Plating Problem 2,739, published in our September issue.

Q.—Will you kindly publish a formula for a good bright yellow brass solution that may be used to plate the inside of some silver plated boxes which are then to be finished with a flash gilt?

A.—For a good bright yellow brass solution try the following formula:

Water	1 gallon
Sodium cyanide	4½ ounces
Copper cyanide	3 ounces
Zinc cyanide	1 ounce
Soda ash	1 ounce
Sal ammoniac	½ ounce

Use a low voltage and good yellow brass anodes.

For the brightener to be used in connection with the above prepare a solution as follows: In a quart bottle place one ounce of bisulphide of carbon and 1½ ounces of chloroform and ½ ounce of white powdered arsenic. Fill up the bottle with a solution of cyanide of sodium, using about 4 ounces. Every evening after working the solution through the day add 1 ounce in the proportion to a hundred gallon solution.—C. H. P. Problem 2,739.

The previous solution gave copper carbonate and zinc, instead of copper cyanide and zinc cyanide, due to a typographical error.

Owing to the printers' strike in New York City, our reading pages in this issue are not complete.

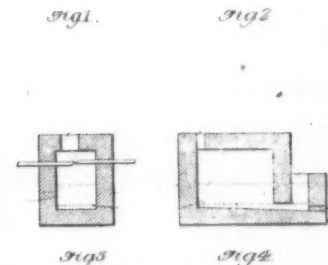
We will make up the deficiency in future issues.

PATENTS

A REVIEW OF CURRENT PATENTS OF INTEREST

1,312,480. Aug. 5, 1919. **Method of Refining Zinc.** Swen Hultdt, Stockholm, Sweden, Assignor to Norsk Elektrisk Metalindustri Aktieselskap of Sundløkken, Sarpsborg, Norway.

The present invention has for its object to provide an improved method of refining zinc, whereby refined zinc of the desired degree of purity is obtained with economy in heat and in a continuous manner.



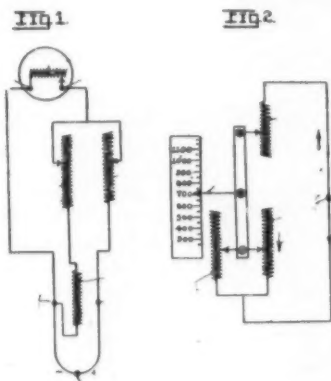
The refining operation according to the present invention is carried out continuously by the employment of radiant heat produced by electrical means and by employing special means for obtaining zinc of great purity, uniformity in operation of the refining process and economy in the amount of current consumed.

In the accompanying drawing Figure 1 is a transverse section and Fig. 2 a longitudinal section of a furnace for refining zinc according to the present invention, proportioned as above described. The zinc to be refined is assumed to contain 0.5% of lead, and the bath surface is given the size of 0.5 square meters. 1 indicates the furnace, and 2 the electrodes projecting through openings in the furnace walls, and establishing an arc for heating the zinc bath contained in the furnace. 3 indicates a receiver in communication with the furnace chamber at the bottom thereof, and serving as a sealed inlet, through which the zinc to be refined is fed into the furnace chamber. 4 indicates the escape opening for the refined zinc vapors.

Figs. 3 and 4 are views similar to Figs. 1 and 2, illustrating a furnace for refining zinc containing 15% lead. The depth of the zinc bath in this furnace will be 100 centimeters.

1,312,951. Aug. 12, 1919. **Pyrometer.** Emerson L. Clark, of Lakewood, Ohio, Assignor, by Mesue Assignments, to National Carbon Company, Inc., a corporation of New York.

This invention relates to pyrometer systems and provides means for correcting inaccuracies due to change in temperature of cold junctions in the thermopile, as also described in the application Serial No. 737,640, filed Dec. 19, 1912, of which this application is a division.

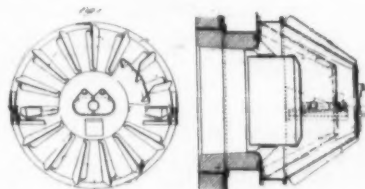


In thermopiles the "cold junctions" generate E. M. F.'s, but in a direction opposed to the E. M. F. of the hot junction. The E. M. F. impressed on the galvanometer is therefore less than that of the hot junction. Consequently allowance must be made for the E. M. F. of the cold junctions in using the thermopile to determine temperatures. If the temperature of the "cold junctions" is maintained constant the correction would be a simple matter as the galvanometer would be calibrated for the drop in E. M. F. caused by the counter E. M. F. However, the temperature of the "cold junctions" cannot easily be maintained constant in practice. It is, therefore,

necessary to provide means to compensate for such change in the temperature.

1,312,378. Aug. 5, 1919. **Air-Valve for Furnaces Using Liquid Fuel.** Harold E. Yarrow, Glasgow, Scotland.

The invention relates to means for controlling the flow of air to a furnace burning liquid fuel and comprises a valve which is adapted to control the supply of air and at the same time to act as a safety device to prevent, in the case of a "blow back" or rise of pressure in the furnace, the escape of air, gas or steam into the stokehold. The construction of the valve and of the valve seating also allows a whirling motion

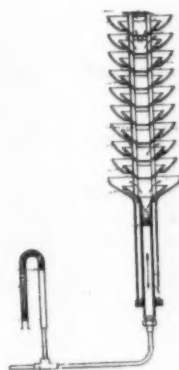


to be imparted to the air entering the furnace.

In the accompanying drawing which shows an example of a construction according to the invention, Fig. 1 is a front elevation and Fig. 2 a section on the line 2-2—Fig. 1.

1,310,727. July 22, 1919. **Electrode.** Carlo Zorzi, Italy.

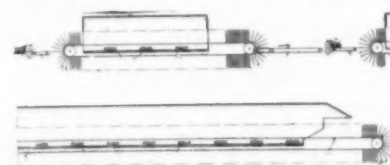
The present invention relates to improvements in electrodes; and it comprises an article of the general class or character indicated which is made up of a plurality of separate elements arranged in superposed relation in the form of a pile, and so constructed as to conduct the liquid or gaseous products of electrolytic decomposition to a single receiving vessel.



An electrode embodying the invention is illustrated diagrammatically in vertical section in the accompanying drawing, and comprises, as shown, a superposed series of open-topped elements mounted coaxially and in spaced relation upon vertical supports which, in turn, are fixed to a base of conducting material. These elements are in the form of truncated cones or pyramids of uniform size and shape, which may have either plane or wavy surfaces; and each of them is provided with an encircling cap or ring of insulating material, which is connected to it intermediate its upper and lower edges.

1,312,815. Aug. 12, 1919. **Process of Lacquering Sheet Metal.** Thomas Lucien Taliaferro, Chicago, Ill., Assignor to Phoenix-Hermetic Company, Chicago, Ill., a corporation of New York.

The invention relates to a new and useful improvement in the process of lacquering sheet metal, and more particularly to a process which contemplates the lacquering of both sides of a sheet of metal or the applying of two coats of lacquer to



one or both sides of a sheet of metal.

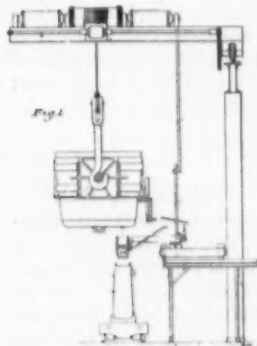
Prior to this invention it has been a common expedient to

coat sheet metal with an acid resisting lacquer made from a combination of oils and gums which, when subjected to a baking temperature forms a comparatively hard acid resisting surface. It has been the usual practice to lacquer one side of a sheet of metal and then subject the same to a baking temperature until the particles of the lacquer become fused or amalgamated, after which the other side of the sheet of metal is lacquered and the sheet again subjected to a baking temperature. In the carrying out of this process considerable time is required as the sheet of metal must be subjected to the baking temperature for an interval of time necessary to bring about the twice baking of the sheet. On the other hand, the side of the sheet which is first coated is twice subjected to a baking temperature and this often results in a discoloring of the lacquer.

An object of the present invention is to provide a process of lacquering sheet metal, wherein both sides of the sheet may be baked simultaneously, thus avoiding the objection to the twice baking of one of the lacquered surfaces and also materially cutting down the time required to lacquer and bake the sheets.

1,312,164. August 5, 1919. **Metal Casting Apparatus.** John C. Cromwell, Cleveland, Ohio.

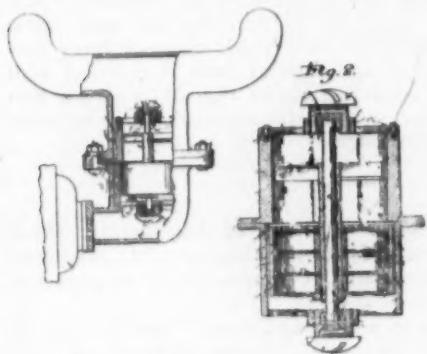
This invention has relation to metal casting apparatus, of the type employed in casting large objects, such as ingots, etc. In the casting of such objects, it is found desirable to use a trough or runner system intermediate the casting ladle and the mold for the purpose of distributing the flowing stream of metal between a plurality of molds.



Heretofore it has been customary to provide means for attaching the trough or runner system to the casting ladle itself; but this is in many respects objectionable for various reasons. This invention is designed to provide a simple and convenient form of crane mechanism for handling the runners or distributing troughs.

1,312,240. August 5, 1919. **Mixer.** Charles W. Ervin and William E. MacGuire, Anaconda, Montana.

This invention relates to the art of fuel homogenizers, and particularly to a device of this kind adapted especially for use in internal combustion engines and carbureters of automobiles.



The invention in its broadest aspect aims to provide an improved device for mixing the fuel, thereby increasing its combustibility, in order to render each charge more efficient, prior to entering the combustion chamber, through the intake manifold.

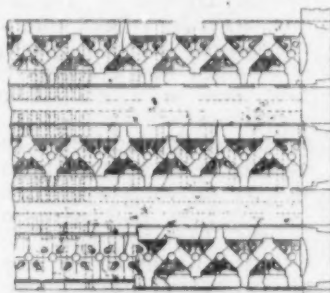
Further it is the aim to provide means located between the intake manifold and the carburetor, and being intermittently revoluble under the influence of the fuel or charges, incident to the intake strokes of the piston of the engine, and in which means revoluble screening devices are included, not only to screen the fuel, but also acting to break or disintegrate the particles, thereby insuring a finer and superior combustible fuel.

The invention further aims to afford an additional revoluble member in advance of the screening devices to further break the particles of the fuel, imparting a fanning action thereon, which will agitate and thoroughly mix the charge.

The invention further aims to provide supporting means, on which the intermittent revoluble means is supported, there being means afforded, such as cup-shaped agate thrust bearings for the supporting means, whereby the intermittent revoluble means may easily and freely rotate under the influence of the fuel in its passage through the manifold.

1,312,301. August 5, 1919. **Coking Retort Oven.** Joseph Becker, of Pittsburgh, Penn., Assignor to the Koppers Company, of Pittsburgh, Penn., a Corporation of Pennsylvania.

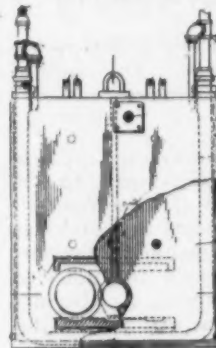
This invention relates to coking retort ovens, and more particularly to those of the well-known Koppers cross-regenerator type, exemplified in the Koppers coke-oven Patents 818033, 1026169 and others, and also more particularly relates to coking retort ovens, whether of such cross-regenerator type or otherwise, having the flue-construction set forth or claimed in the Schwab coke-oven Patent 989302, and also more particularly relates to such



other coking retort oven constructions as are herein-after set forth or claimed. And the invention includes among its objects an increasing of the coking efficiency of such ovens, an increasing of their flexibility of operation, a reducing of their cost of maintenance, an increasing of their permanence and durability and resistance to the strains and variations of the high temperature conditions to which they are subjected, and such other improvements or advantages in construction and operation as are found to obtain in the structures and devices hereinafter described or claimed.

1,312,168. August 5, 1919. **Water-Cooled Door for Furnace.** George F. Downs, Buffalo, New York.

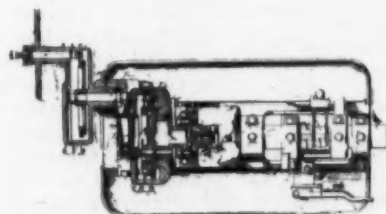
This invention relates to improvements in water-cooled doors for furnaces and consists of the matters hereinafter described and more particularly pointed out in the appended claims.



The invention as illustrated herein, is shown embodied in a door for open-hearth furnaces, where its use is of especial advantage owing to the intense heat; but, as will appear, it is in no way limited to such use, as it may be advantageously employed in connection with other types of furnaces. The drawing shows a view showing, on an enlarged scale, the door itself in front elevation, with the front wall partially broken away.

1,312,394. Aug. 5, 1919. **Metal Working Machine.** George Gorton and George E. Gustafson, of Racine, Wis.; said Gustafson Assignor to said Gorton.

This invention relates to certain improvements in and relating to routing and other metal working machines; and the



objects and nature of the invention will be readily understood by those skilled in the art in the light of the accompanying drawings illustrating what we now believe to be the preferred mechanical expression and embodiment of the invention from among other constructions, arrangements and combinations within the spirit and scope thereof.

An object of the invention is to provide apparatus peculiarly adapted for accurately routing or cutting the grooves in fuse rings for explosive shells.

